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Dyeing by Electricity. ELECTRICITY has to shoulder much blame at the hands of the public. Here is the latest case: An Englishman entered an electric car clad in garments of irreproachably neat design and color. When he left the car these colors, especially on the lower parts, had been changed to a bright flaming red. As this does not happen in horse cars the mysterious electricity must have done it. The report goes on to state that an advantage of this dyeing process is that no charge was made for it, but that an attending disadvantage is that you cannot choose your color. It does not state that the car was run with storage batteries.

Question Column. WITH the present issue of THE ELECTRICAL WORLD we add a new feature in the form of a query column, which we hope will prove both interesting to the readers and useful to the correspondents. There are many hard workers and thinkers in the electrical field who often meet with problems and questions which they cannot answer. There are, on the other hand, many readers of THE ELECTRICAL WORLD who are able and willing to answer such questions if they are given an opportunity. There is also another class of readers who are both benefited and interested by such free discussions. The practical value which this column will have to our readers will depend largely on the willingness and ability of those who send in answers to the questions, or discussions regarding them.

Closed Conduit Sectional Roads. ALTHOUGH the overhead trolley system is satisfactory in most respects, there are still thought to be sufficient objections to its use in large cities to offer great inducements for inventors to devise some means for overcoming the use of this so-called "deadly" trolley (which is not known to have ever killed any one). The storage battery system must wait for the invention of a new form of battery or for radical improvements in the present form. In the conduit systems the open slotted conduit must be perfectly well drained, which is difficult in countries like ours, where heavy precipitation of rain in great quantities may be expected at any time. It is not unlikely, therefore, that the most probable solution will be the closed conduit with surface conductors made alive by the car itself. The indefatigable inventors will therefore probably do best to give their attention to this form as the one which is most likely to meet with the fewest objections from municipal authorities and the electrical companies.

Workshop Appliances. THE introduction of the two and three phase alternating current systems has shown the need of some practical instrument or device for measuring the difference between the phases of two or three alternating currents, known as the angle of lag. Although this may be measured or calculated by various methods which are more or less complicated, usually more, there is always room for simple workshop methods and devices, which, though they may be crude, are nevertheless often more satisfactory because they are simple and may be put into the hands of workmen. Such a device for indicating when the phases are at 90 degrees from each other is described by Mr. Horry in another column and is worth the attention of practical workers in this field. It consists simply of two electromagnets, one in each circuit; when each pole attracts each of the other two equally, the difference of phase is 90 degrees. This is such a simple device that it may be constructed in any workshop at an exceedingly small cost, and will doubtless prove very useful in both workshop and laboratory.

Synchronous Motors. GREAT stress has often been laid on the idea that a very excellent quality of synchronous alternating motors lies in the fact that their speed must of necessity be exactly the same as that of the generator. While such a quality is undoubtedly a good one, it should also be remembered that it is attended by a serious disadvantage which constructors should bear in mind in designing the machinery for such systems. The fact is well known that if overloaded too much, such motors come to a dead standstill; this, makers say, is not serious because if well constructed a motor should be able to stand an overloading of 100 per cent. before the speed falls. According to a competent authority, there is another feature, however, which he claims is a great source of trouble in existing plants. He claims that if the speed of the engine varies, say it diminishes momentarily, then that of the generator will fall and as it rises again a moment later the motor, if it has a heavy armature, will not be able to follow as quickly as necessary, thus throwing the two out of synchronism. He claims that much of the trouble experienced with synchronous systems in use is due to this cause. In order to avoid this it appears that the fly-wheel action of the armature of the generator should be as great as possible and that of the motor as small as possible, so that the former will tend to maintain an even speed and the latter will tend to respond quickly to any changes should they occur.

Incandescent Lamp Economy. THE study of the incandescent lamp has been carried on for the past ten or more years by the physicist, the manufacturer and the consumer from every possible point of view, and a very interesting field of research it has proved to be. The literature of the incandescent lamp is now probably as complete and satisfactory as that of any branch of the practical applications of electricity. Its physics are fairly well understood, its performance under varying conditions has been carefully studied, and the type of lamp required for securing the greatest economy with any given conditions of operation can now be furnished with a close degree of approximation. This latter feature, however, is one to which too little attention has been given, although it is of the highest importance in the economical operation of central stations. It is too often assumed that what is an economical lamp for one station and for one set of conditions must necessarily be so for any other. A good résumé of this whole subject will be found in the article by Prof. Roberts printed in our columns this week, in which the problem is treated from the practical standpoint of both the station manager and the consumer. The study of the relations that should exist between the different factors that determine the proper lamps for use in any given case will be found not only interesting, but very profitable to every station manager who will attack the problem in a systematic and conscientious way. Care should be taken, however, to accurately determine in advance the various items of cost, as the value of the final results will depend very largely upon the care and exactness with which these factors are chosen.

Railroads Operated Electrically. WE note with pleasure that a beginning is being made in paving the way for the use of electricity to replace steam on railroads by the Railroad Committee of the Massachusetts Legislature, who have just reported unanimously in favor of a bill which says that all steam railroads of that State "are hereby authorized to operate their railroads by electricity." This is an important step, and we trust it will be followed rapidly by similar acts in other States. The movement was originated by the late James T. Furber, who was said to have been decidedly in favor of the use of electricity for interurban railroad traffic. It is stated that the Old Colony and the Boston & Albany roads are ready to proceed at once with a practical trial of the application of electricity to the ordinary railroad cars. One of the members of the committee of the Legislature went so far as to say that he thought within one year railroads in Massachusetts will be operated exclusively by electricity as a motive power. While we cannot hope with him that the limit of time which he gives will be so short, yet we are thoroughly of the belief that the time will come sooner or later; it requires only that a good beginning be made, and if it can be shown, as is likely, that electricity is cheaper than steam, it will not be long before its adoption will become almost universal. Should it not prove to be cheaper, but only more comfortable for the traveler, we are afraid it would take a long time to introduce it, as railroads in this country are operated to give the greatest dividends rather than the greatest comfort and speed. It is only when the latter is accompanied by a greater income to the company that it receives proper consideration.

The Telephone Monopoly. IT appears to be the prevalent opinion among the general public, induced chiefly by the newspapers, that the whole telephone industry will be thrown open to the public on the early expiration of the fundamental patents, and that after suffering at the hands of this monopoly for so many years we can now look forward to the time in the near future when we will at least have good service at reasonable prices. A little reflection, however, will show that this is a very superficial view of the subject, and that the probabilities are that the bright future is as far distant as it ever was. To be sure, the expiration of these patents will enable any one to build a telephone of that pattern and to transmit speech electrically without paying a great price as a patent royalty, but this privilege does not give us new telephone companies in our large cities; to start new competing companies requires more than this. The telegraph is not covered by any fundamental patents, and yet there is no healthy competition leading to good, reliable and cheap service. The telegraph service is perhaps little better at present than that of the telephone companies. To start a new competing telephone company in any of our large cities means to get privileges to run the wires. Air space is cheap, and wherever it is not claimed by the city authorities it may not be expensive to run new lines; but if they must be run underground it requires expensive conduits and still more expensive franchises. In some places the telephone companies have been more shrewd than our city fathers, who are supposed to guard our interests, and have secured a monopoly which is perhaps equal to and longer lived than that of the patent. They have secured such rights of way in some cities as will enable them practically to claim the whole earth or the available space in the earth under our streets. A new company would soon find that it could not run overhead on account of the opposition of the municipal authorities, and that it could not run underground on account of the other companies who are the happy possessors there. Nothing short of a telephone system without line wires would enable them to enter into competition. There is another point which alone would seriously deter a new company from starting. A telephone system is different from that of a telegraph company in the fact that to be successful it must include all the larger business establishments in a city and to have two companies would mean either that each business house must have two telephones or that there must be connections between the two lines, neither of which is likely to be satisfactory. Private lines and telephone companies in small cities will undoubtedly be benefited by the expiration of these patents and there will be a large industry opened in the introduction of telephones for such purposes. We may perhaps also expect a slight improvement in the service in large cities in order not to make competition too inviting, but aside from this it is not probable that the public will be benefited very much by the expiration of the patents, at all events the benefits are not likely to be as great as our newspapers lead the people to expect.

Curious Magnetic Phenomena.

BY WILLIAM SMITH HORRY.

It is well known that like magnetic poles repel each other and unlike poles attract. This is true when a permanent magnet attracts a piece of iron, the iron having induced in it a polarity opposite to that of the pole which attracts it. It is also true when the poles are those of alternating current magnets. When, however, two bar electromagnets are energized by alternating currents of the same period, but which differ in phase by 90 degrees from each other, the effect is quite different from anything we are accustomed to in magnetism; in this case either pole of one magnet attracts either pole of the other and there is no repulsion anywhere. The pull resembles the pull of a permanent magnet on its armature. This resemblance, however, is only apparent, in reality there are two minute periods of repulsion to every period. It differs, then, from the magnetism produced with either constant or alternating currents in its dynamic qualities. The effect of a constant current on these electromagnets is a constant attraction or repulsion, while that caused by the alternating current as generally distributed is a pulsating one, which may be represented by a wave line entirely on one side of the zero line. The attraction between two magnets in which the alternating currents are at 90 degrees difference in phase might be represented by two flattened wave lines which cross the zero line at the same point, thus showing continual attraction.

Two such electromagnets are, therefore, of great value in determining the quadrature of currents, as is necessary for running motors on the Tesla principle. With the currents at the proper 90 degrees phase difference all the poles attract each other equally, but should the phases not be exactly in quadrature the attraction, though it will exist, will be unequal between the different ends.

This method of finding the correct angle of lag for running motors is very simple and can be done with very simple apparatus. When the angle is quite different from 90 degrees, Blakesley's method with three dynamometers must be used, but for this especial angle (the one commonly used) this ready method will be found quite satisfactory.

The two-phase currents can be obtained from transormers in many ways.

Researches on the True Electro-Chemical Equivalent of Copper.

A determination of the true electro-chemical equivalent of copper has recently been made by J. Vanni, who contributes a paper describing his investigation in the *Annalen der Physik und Chemie*, series II., vol. XLIV., pp. 214–221.

The electro-chemical equivalent of copper appears to vary under certain conditions; this was established by Gray some time ago [*vide Philosophical Magazine*, series V., vol. XXII., p. 389, and vol. XXV., p. 179], who found that the magnitude of the "constant" varied at 12 degrees Centigrade from 0.0003287 with a current density of 20 milliampères per square centimetre at the cathode, to 0.0003278 with a current density of 3.3 milliampères; and at 35 degrees Centigrade so low as 0.0003245. It may be remembered that Gray, in endeavoring to explain this variability, advanced an observation made by Gore, namely, that the solution of sulphate of copper dissolves up a quantity of copper varying under different conditions.

The object of Vanni's investigation was to test validity of the explanation advanced by Gray, as well as to determine, if possible, the true electro-chemical equivalent of copper. About 10 pages are occupied in the *Annalen* with a description of the apparatus, the method of making the observations, and a consideration of the results; but the pith of the paper is as follows:

Two copper voltameters, with plates of different areas, were placed in the same circuit; the surfaces varied in the proportion 4 : 1. With a solution of sulphate of copper, for example, containing one per cent. of free sulphuric acid, it was found that 0.1903 gramme of the metal was deposited on the larger cathode, while 0.1960 gramme was deposited on the smaller cathode during a period of three hours.

The current in this case was interrupted, and the cathodes were allowed to remain three hours longer in the solutions. It was then observed that the larger cathode had lost weight owing to some of the copper having dissolved, presumably, in the sulphate solution. The larger cathode had lost 9.2 milligrammes, but the smaller cathode only 3.2 milligrammes. If these losses be added to the weights deposited we obtain the following results:

0.1903	gramme	and 0.1960	gramme.
0.0092	,,	,, 0.0032	,,
0.1995	,,	,, 0.1992	,,

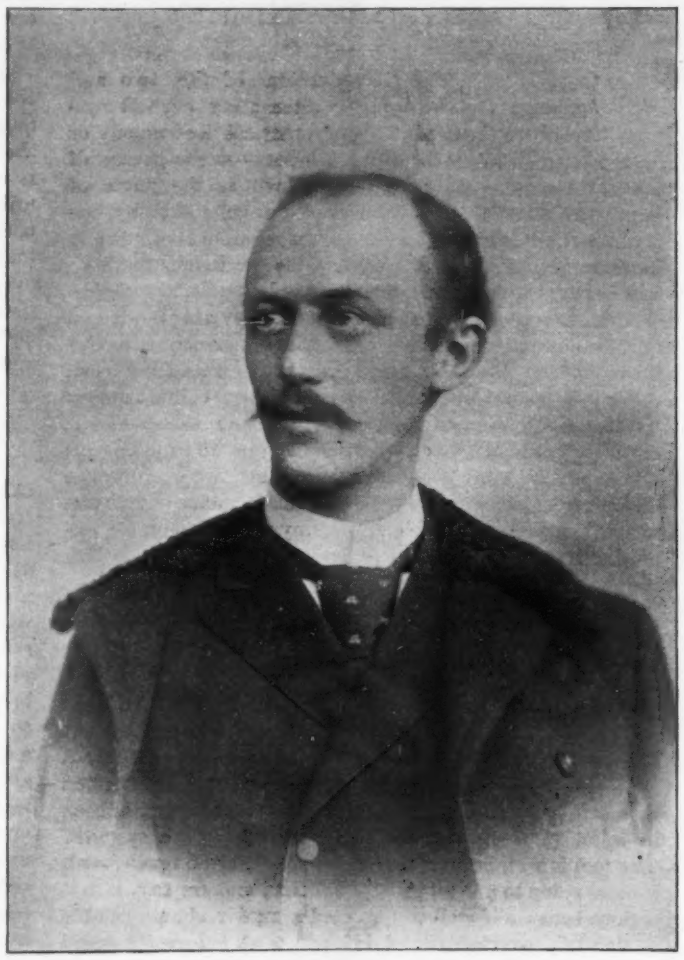
These results, differing as they do only by three in the fourth place of decimals, are sufficiently close, and show that Gore's explanation of the apparent variability of the electro-chemical equivalent is valid. Results were obtained, the mean of which is taken by Vanni as the true equivalent of copper in cupric salts: this mean value is 0.0003284, that of silver being taken as equal to 0.001118.

ELECTRICAL WORLD PORTRAITS.—NO. XXXII.

MICHAEL VON DOLIVO-DOBROWOLSKY.

The recent rapid development of the application of alternating currents for power purposes, as shown in the Frankfort exhibition, has brought to the notice of electricians the work of a young and very able German electrician, who has been spending much time during the past years in developing the three-phase and multiphase systems, which are so well adapted for motor purposes. Whoever may be the inventor of this system, it must be admitted that the researches of this engineer, which led to the now famous Lauffen-Frankfort power transmission, have been of great value in developing and bringing before the public in the form of a practical plant a system which appears to have such a bright future. We are pleased to be able to add to our collection of biographies this week a short sketch of his career.

Michael von Dolivo-Dobrowolsky was born in St. Petersburg on the 3d of January, 1862. His father was at this time Counselor to the Russian government, and Director of the City Orphan Asylum. At the age of 11, he went with his parents to make his home in Odessa, where he took the course in the high school. At that time he was very much interested in chemistry, and at the age of 16 was already making elaborate quantitative chemical analysis. He began his higher studies in 1878 at the Polytechnicum in Riga, in the department of chemistry. Here he remained 2½ years, and then went to the University at



M. v. Dolivo-Dobrowolsky

St. Petersburg to attend the lectures of the distinguished Prof. Mendelejeff.

In the years 1880 and 1881 his interest in the subject of electricity began to develop, and in the latter year he had exhibited in the Electrical Exhibition in St. Petersburg his first invention, a new battery, which, two years later, in the Exhibition at Vienna in 1883, received very favorable mention. His interest and his studies in chemistry led him to the subject of electricity through that department, and at first most of his attention was devoted to electro-chemistry. At the end of 1883 he went to Germany to study electro-technics, under Prof. Kittler, in Darmstadt, as he had then decided to make it his life study. In a very short time he had advanced so rapidly and showed such abilities, that he became the assistant and the laboratory instructor at this institution, as successor to Mr. Carl Hering, who resigned that year.

In order to perfect himself also in the practical application of electricity, he spent half a year in an electrical factory in Frankfort, after which he again took up his position as assistant in Darmstadt and continued there up to the year 1887. During this time he also gave a series of lectures on practical and theoretical electro-chemistry at this university which were very well attended, the best kind of proof that they were well prepared, because in Germany the students are not compelled to attend lectures as they are here. In May, 1887, he was married in Odessa, after which he went to Berlin, where he became one of the engineers in the Allgemeine Elektricitäts Gesellschaft. Here he very soon advanced to the position of chief electrician, which position he holds at present. The various dynamos and apparatus built by this company were designed by him.

Since 1888 he has made a special study of the question of transmission of power, especially by means of the alternating current, for in studying the subject carefully he was compelled to acknowledge the superiority of the alternating current for such transmission. At the present time the rotary field system as conducted by him is well known to be a technically complete system, developed in all its details. In the transmission of power from Lauffen to Frankfort during the Electrical Exhibition last year, he was prominently connected as the designer and constructor of the motor which rendered this experiment a success as far as the transmission of power to motors was concerned; and he was also connected with the designing and constructing of some of the three-cored transformers used there. Aside from the subject of the invention of this system, it must be admitted that he certainly reduced it to a very practical shape, and that the motor, as exhibited by him, certainly surpassed in many respects any motors heretofore constructed, whether for continuous or alternating currents.

His very interesting paper read before the Electrical Congress this year, and reprinted in full in a recent number of THE ELECTRICAL WORLD, will show the peculiarly and eminently practical and original mode of thinking of this young engineer, who is acknowledged by many Germans to be one of the leading electricians in that country. He is the inventor of numerous electrical devices, among which are commercial ampère and volt meters which are used very largely throughout Germany. He is the author of numerous papers which are noted for their clearness and their practical mode of treatment of the subjects.

Underground Systems for Electric Railways.

BY F. BOLLING.

There are to be found in the patent descriptions of every country propositions for underground electric street railways, which prove by their impracticability that the inventor was not fully aware of the difficulties which are found in this problem. Much time and money was therefore lost in taking out impracticable patents. In the following we will try to lay down some general principles which ought to govern the construction of an underground system, having especial reference to those with insulated rail sections.

The underground systems may be divided into four classes:

1. The two running rails are used as the two conductors.
2. A third, insulated rail is used as one conductor.
3. Insulated rail sections are used and are connected by small feeders to the conductor buried in the ground.
4. The conductor is laid in a slotted channel.

The first would, of course, be the simplest method, but in practice it proves to be the most difficult one, as the voltage can be only very low in order to avoid great losses from leakage and also to avoid dangers from contact with the rails. Furthermore, the wheels have to be insulated from the axles, which is difficult and involves greater costs per car. Then there seems to be some difficulty in constructing a proper device for picking up the current. Altogether, this system does not seem to be very promising. As to the second method, the use of a third rail, all the above, with the exception that the wheels need not be insulated, applies to this system as well, and there is also little hope that it will be worked out in such a way as to make it useful for cities.

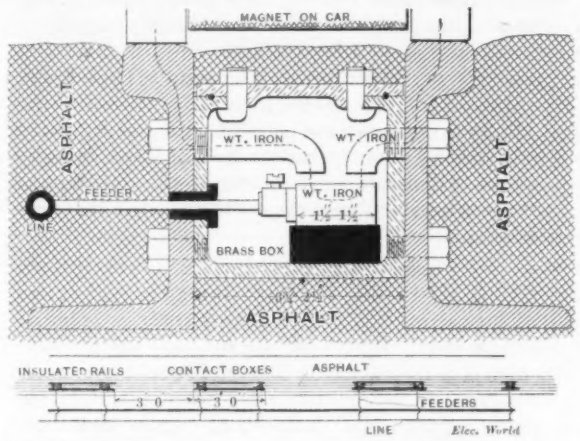
The most promising system seems to be third. This may be carried out in several ways. Rail sections of less length than a car can be imbedded in asphalt or other insulating material, insulated from each other and from the earth, and connected by wires to the mains. On the car is a contact device rolling over these sections, taking current for the motors, which current returns through the running rails. This would be very simple and cheap, but as the rail sections are liable to become short circuited, and on account of the danger to living beings touching two sections, or one section and one of the running rails, it could not be allowed in crowded city streets. In order to lessen the danger of short circuiting the rail sections, they could be laid at intervals of several feet. For instance, assuming a section four feet long, then it could be laid so that one section would be separated from the other by a distance of four feet. The sliding or rolling contact in this case would roll or slide alternately over asphalt and iron, to which there is apparently no objection. However, the danger of completing the circuit by horses or persons exists still, and in order to avoid this open switches have to be put into the feeders, which have to be closed to establish the circuit when the car passes. These switches or contact boxes can be worked from the car mechanically, electrically or by magnets. These devices have to be constructed in such a way that the section does not become alive unless the car passes.

Now there exist already numerous devices of this kind, but as far as we one can see from the descriptions given they are mostly of a complicated construction, more adapted for telegraph apparatus than for street railway work.

There are many parts, springs, weights, levers, electromagnets, etc., and there is, therefore, great liability to get out of order. Last, but not least, they are expensive.

As the practicability of using the third insulated rail depends chiefly on the construction of these switches, we point out here what should be aimed at in designing them. The switches must first of all be of the greatest simplicity, and they must be reliable. They must be constructed in such a way as to allow cheap manufacturing, and finished parts ought to be avoided. For operating them, as little power as possible should be consumed. The switch boxes must be water tight, of easy access, and the parts arranged in such a way as to be easily replaced. In order to accomplish this the arrangement shown in the adjoining figure is suggested. The switch is put securely between two rails. The idea in doing this was to make it easily accessible, give it a secure place in the street, and to obtain a good magnetic circuit (shown in dotted lines), and therefore requiring little power for operating it. The disadvantage seems to be the double rail, but it may be said it is only an apparent one, as the two rails, when imbedded in asphalt, will give a good base, and thereby better resist the traffic of the streets, a matter of great importance, which is overlooked in most of the propositions for such systems. The costs for the additional rail could be reduced by placing the insulated sections 4 or more feet apart, as mentioned above, and by having two small contact carriages on each end of the car, the one being on the section whereas the other rolls over the asphalt. The initial costs for this arrangement will not be larger than for an overhead system.

To work these switches mechanically does not seem to be advisable, as such a switch could then be worked by other vehicles or mischievous boys, whereas with magnets this would not be possible. To work them electrically, the switches have to be of a more complicated nature, having then all the disadvantages stated above.



AN UNDERGROUND SYSTEM FOR ELECTRIC RAILWAYS.

Instead of using switches and feeders connected to the sections and mains, a continuous switch, as it may be called, can be used, as in the Lineff system. But the power consumed in lifting the flat iron strip resting on the bare copper wires in a channel (which has to be pressed against the bottom of the rail), is quite great, requiring 230 watts, and for moving the heavy magnet carriage, 500 watts, making nearly 1 h. p.

Furthermore a channel is required, which has to be drained in order to get a reasonably good insulation, which however can never be so good as in the first cases. The initial cost therefore will also be greater. There exists, indeed, no reason why the whole length of the conductor should be bare, as the system could perhaps be improved by having iron contact pieces, connected to the insulated conductor, laid in a channel every 10 or 12 feet, and lifted by those pieces; or, going a step farther, to do away with the conduit by having, as illustrated above, the main conductor buried in the ground and the exposed parts inclosed in boxes, which may be kept free from moisture more readily than a channel. The Pollock system is also one of this kind, but has the disadvantage, as far as may be judged from the illustrations, that the boxes are not easily accessible and that the magnetic circuit is not good, requiring more power to work the switches.

All these systems offer no particular difficulties at turnouts or curves, whereas with the fourth class, which we will now consider, these disadvantages, besides others, exist to a certain degree. The slotted conduit system has, against the first mentioned, the disadvantage of high first costs, of drainage of the channel, of difficulties at the turnouts and curves, of removing the car from the track, and, finally, the whole may be immersed in water in rainy weather. The construction must be strong, so that the slot will stand the traffic of heavy wagons, etc., and not be closed. The conductor has to be placed so that the dirt and mud of the street cannot fall directly upon it or else the insulation will suffer. Simplicity is also the first thing to be aimed at in this system, so as to reduce the costs. A simple construction could be obtained in using the principle of having insulated rail sections 4 or 5 feet long and separated by an "air gap" of 4 or 5 feet. The conductor in this case can be buried in the ground and connected to the sections, which could be placed as high in the channel as possible, and it would not be of great importance, when dirt falls upon them, as they are not charged, unless the car passes. Of course, the difficulties at the turnouts remain the same.

In summing up, we find that the sectional insulated rail offers the best and simplest way of underground current supply to a moving car, and there is no reason why costly slotted conduits should be built in order to conduct the current. The channel systems have only the advantage, when compared to the insulated rail sections, that they have been tried in several cases on a large scale and have in two cases (in Blackpool and Buda-Pesth) proved successful. There is no apparent reason why the other system would not do the same if tried on a larger scale.

Normal and Hissing Arcs.

BY J. R. CRAVATH.

The electric arc has heretofore been investigated more from a purely electrical than from a broad physical stand-

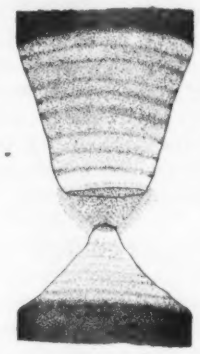
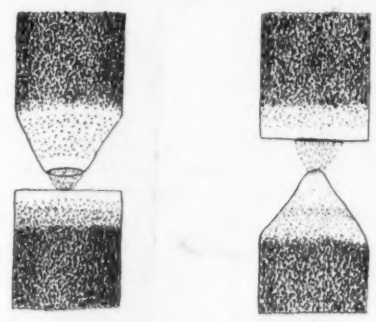


FIG. 1.—THE NORMAL SILENT ARC.

point. The relation of voltage, current, resistance, etc., in different arcs has received more attention than the action taking place in the arc itself. In other words, the arc has been dealt with through the agency of the voltmeter and ammeter, rather than "face to face." The electrical part of the work having, therefore, been pretty thoroughly done, this paper will treat only of the action of the arc itself.

The normal, silent carbon arc, Fig. 1, consists of a stream of carbon vapor appearing to arise from the boiling crater on the positive carbon and touching the white hot point on the negative. This cone shaped stream of vapor burns where it comes in contact with the surrounding air. The whole surface of the crater is in a steady boil and gives off



FIGS. 2 AND 3.—EXPERIMENTS UPON CARBON ARCS.

vapor equally from all parts. However, under certain conditions, the arc will hiss and become unsteady.

The conditions which produce hissing are: first, air currents, carbon impurities, etc.; second, shortness of arc. The following simple tests were devised by the writer during his investigations to locate definitely the part of the arc which is responsible for the hissing. Owing to the fact that hissing is always accompanied by unsteadiness, it was reasoned that it might be due to the changing of position of the vapor stream on either the positive or the negative carbon tips, and that the sound was caused by either the heating or cooling of the hot carbon, or by condensation of vapor on the negative.

An ordinary arc lamp was so fixed that one of the car-

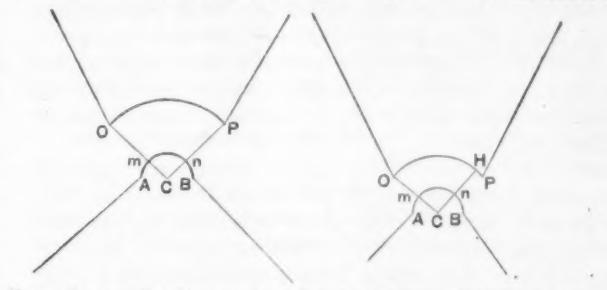
FIG. 4.—THE HISSING ARC.

bons could be moved in a horizontal direction without changing the length of the arc. It was then fitted with carbons, as shown in Fig. 2, using an ordinary carbon (burned to the regular shape) for the positive, and one having a flat end for the negative. If now an arc be struck between these carbons any horizontal movement of one of them will simply change the spot on which the vapor strikes the negative without influencing the positive in any way. This movement was made when the arc was burning silently, and the arc continued to burn silently during the movements, showing that the hissing was not due to condensation on the negative.

The carbons were then reversed, using a pointed one for the negative and a flat ended one for the positive, as seen in Fig. 3. In this case, of course, the positive crater will be obliged to change its position at every horizontal movement of the carbons. In this test every movement was accompanied with a hiss, showing that hissing is caused either by the sudden heating of the carbon to the boiling temperature of the crater, or by the sudden cooling of the boiling carbon formerly in the crater. The former theory seems most probable, for if the latter were true every arc lamp would hiss when the current is turned off, and this is not the case.

In the light of these experiments there is no difficulty in discovering the immediate cause of the hissing in short arcs. In looking at one (Fig. 4), we see that, instead of a stream of vapor coming from the entire surface of the crater, there is a stream coming from only a part of the surface, and that the rest of the surface is at a temperature below boiling. The immediate cause of the hissing must be the fact that the boiling surface is constantly changing its position in the crater, and so constantly raising cool carbon to the boiling point.

The question still remains: why does not the evaporation cover the crater surface in the case of the short arc as in the case of the normal arc? With the idea that the vapor stream might have a certain geometrical relation to the crater, a system of measurements was begun on normal arcs, using the same current and quality of carbon. The measurements taken were on the diameter of crater, depth of crater, length of arc and diameter of the knob on the negative carbon. Fig. 5 is a diagrammatic section through an arc. The figures from which this was drawn were obtained by measurements of normal 10-ampère arcs, using a good quality of soft carbon. *O P* is, of course, the crater, and *A B* the negative tip or knob; *O m n P* is the vapor of the arc. The striking thing about this diagram is that *C* is the centre from which *m n* and *O P* are described.



FIGS. 5 AND 6.—DIAGRAMMATIC SECTIONS THROUGH ARCS.

This, however, shows what might be expected, namely, that the arc burns away the carbon, so as to keep all points at an equal distance from each other.

When it comes to the short hissing arc the measurements are more difficult. That is, the measurements taken on the normal arc will not amount to anything because the vapor stream, as was said before, does not come off from the entire crater but only from a part. Of course, exact measurements of the area of evaporation could not be made, but by examining the crater after the current was turned off the area of the evaporation surface, just before it was turned off, could be noted by the peculiar appearance of the crater. By taking a number of measurements in this way, accurate enough results were obtained to draught a diagram shown in Fig. 6. It will be seen that the angles *m C n*, in Figs. 5 and 6, are nearly equal, and I think it is safe to assume that if *O H*, Fig. 6 (the area of evaporation in the short arc), could be obtained with absolute accuracy, the angle at *C* would be equal in both cases. The diameter of the crater *O P* is smaller in the short than in the normal arc, but there seems to be a point beyond which the crater ceases to decrease in diameter to correspond with the size of the vapor stream.

At this point the evaporating surface not being confined to a particular area, the arc begins to hiss. It is manifest that as the arc shortens, the crater will become more and more concave, and of course its edges will necessarily become sharper. The heat of the arc tends to wear away the edges of the crater, but as the arc is shortened and the concavity becomes greater, the edges do not wear away fast enough to keep down the crater surface. In the short arc the heat at the carbon tips is less than in the normal, and this fact will help to keep the crater edge from wearing. I use the word "wearing" to cover the three processes, namely, evaporation, combustion and disintegration, which consume the carbon outside of the crater. By evaporation in the crater I mean the active boiling which takes place there, though evaporation in general does not imply boiling. The decrease of heat which accompanies the short arc can be accounted for by the decrease of boiling crater surface.

The wearing of the crater edges will also depend on the quality of carbon used, and this is one of the reasons why some carbons will burn quietly with a much shorter arc than others.

The facts brought forth here do not pretend to be the results of any elaborate investigation, as they are no more than can be found out by any one with the use of an ordinary arc lamp. At any rate, it is safe to say that there is much yet to be written and discovered about the common every day direct current arc.

The Electric Transmission of Power.*

BY DR. LOUIS BELL.

Taking the whole subject of the transmission of power, we may conveniently divide it into two portions, two separate problems, if you please; one of them the distribution of electrical power rather than its long distance transmission—the case which often comes up in cities where power is generated at a central station and then distributed to motors at various points where it is needed. Here, fortunately, the conditions are pretty well understood. They are practically those that belong to central station practice, with such modifications in the wiring as may be necessary on account of the variations of the load which is put on the motors.

The second part of the subject is the transmission of energy from a point where it can be cheaply generated to a point where it is badly needed. This phase of the subject is assuming more and more importance every day; and although under certain conditions it runs very closely into the former case, it yet has very peculiar characteristics of its own. For example, you may have at various points need for motors for the supply of power to a group of mines. This is a case which is not infrequent at the present time. If you were to erect a power station right in the centre of the group you could supply the power very conveniently if coal were cheap and labor not unreasonable.

That would simply be an exaggerated case of central station practice, that kind of central station practice which is intended exclusively for motor service. However, coal may be very high, as it frequently is in mining regions of Colorado, for example. But at some distance away we may have water power. In that case we could simply send the energy electrically and distribute it from a central station, operated by an electric motor instead of a steam engine. This is one of the very simple cases where the two problems run into each other, perhaps as simple a case as we could have. It amounts only to taking a single large unit of power at one point and carrying it to another.

Then, again, we may have another case of long distance work, this, perhaps, being the more common. For example: we have here a group of mines or a series of small towns, or whatever it may be, where electricity is needed, scattered along at various points, and we have to supply them all from a single point.

There the circumstances become somewhat more embarrassing, frequently very much more embarrassing. But the palm for inconvenience must be awarded to the third case of long distance work, where we have no such arrangement as this which I have shown, where a large number of motors are to be supplied, but where two or three motors of considerable size must be supplied as before from a distant point. It is the meanest case one can possibly meet, I think, in the transmission of power, because the conditions which require nearly constant speed in the motors make the method of securing that particular condition, and at the same time economy, very difficult.

Now as to the method of solution in these three cases which I will enumerate again: First, the supply of a condensed group of motors, which is equivalent to the supply of a central station. Second, the supplying of a scattered number. Third, and worst, the supplying of a few large motors. Of course the first and simplest method is to put in a generator of sufficiently high tension to carry the current over a reasonably small wire, and either use it to operate a motor generator, or under certain circumstances compounding the generator for the centre of distribution, and then distributing just exactly as you would if it was a central station. Probably in most practical cases you could use specially wound railway generators for the purpose and work 500-volt motors at the other end. That problem really solves itself, because the methods and apparatus are tolerably familiar to every electrical engineer.

Eventually, however, the distance from the point of supply to the centre of distribution becomes so great that those conditions will not suffice to meet the requirements of the case. In that case we must either use very high tension directly, or with transformers, so that the second general case is really a transformer system, because we have to use motor generators or alternating transformers anyhow when the distance becomes so great that the drop would be impracticably large if we attempted direct supply. This second general case involves, then, a transformation which may be either direct or alternating. In a direct transformation we could use either a very high tension direct current machine, driving a motor, and thence a generator, or synchronous or polyphase alternating, also driving generators. And then we come to that form of alternating system which seems now to have arisen to the magnitude of a popular cult. Just exactly what its nature is to be it is hard to say. At present it is viewed with something akin to awe. I refer to the three-phase system on which so much comment has been made. And so finally, we have an alternating system of distribution where alternating motors are used.

Now, as you know, each of these three particular systems, with their modifications, have characteristic advantages. Where you can use direct supply—and the cases are more numerous perhaps than the average man would think—it is very effective indeed, and thoroughly economical.

*Abstract of an address before the Chicago Electric Club.

It simply amounts to feeding a network at a distant point, a problem with which any central station man is able to cope; and where the distances are not great, and conditions upon the motors are not very severe the method will prove successful, even if the distance is as high as five or six miles—perhaps ten miles. The condition for success is that the number of motors shall be considerable, so as to give a fairly even load, because if you do not have a fairly even load, if you attempt that supply by a long feeder, the variations in the drop of the feeder will be so great as to make embarrassing variations in the speed of the motor. In a great deal of work it is not desirable to have more than 10 or 15 per cent. variation in speed; and where the load is very variable and you are feeding over a very long feeder you are quite likely, indeed almost certain, to get more variation than you want. That is just the feature that makes the supply of the few large motors so very difficult. Where you are dealing with one, almost anything will answer the purpose. Two direct current series wound machines can be combined so as to run almost as well, almost as uniformly and neatly as if they were fastened together with ropes. They will run synchronously, and where a single unit is to be delivered over even quite a long distance, that particular procedure may prove thoroughly successful. Where you have more than one unit it becomes embarrassing.

So much for direct supply; though I should add that where but a single unit is to be supplied you can use a synchronous alternator as well as anything. In fact, it has some advantages on account of the absolute synchronism. It is very convenient if you are going to supply lights at the other end of the line.

Second comes the cases of distribution involving transformation. Now that may mean a wide variety of things, because in such a case you are operating either a central station at a distance, or are using alternating current transformers, and working perhaps three-phase motors at the other end, or two-phase motors—anything that the state of the art may render practicable.

And then finally comes the alternating system, with special alternating motors. I rather doubt whether at the present time if the average electrical engineer were asked on this system to put in an extensive plant on short notice, he would take the offer without hesitation. Even in Germany, where the three-phase system has reached a special development, it has not been experimented with sufficiently to prove to us exactly what it is going to do. It is, in all human possibility, no better in its operation than a good shunt wound motor at all events. And, as I just mentioned, a shunt wound motor will play queer tricks where the variations in the drop on the line are very great. I do not see any reason why the three-phase motor should be exempt from the general law, although it does have the advantage of convenience in certain cases. Its efficiency is not probably quite as high as a good continuous current motor. Then aside from that there are the alternating current motors, either synchronous or run by special devices. Then you have the Ganz machine, which is said to be quite effective. It has an efficiency of 85 per cent. or so, will stand a reasonable amount of overloading, is self-starting, and has given experimentally good results. In this country we are promised by Mr. Stanley a motor which will fulfill many of the necessary requirements.

So much for the general conditions of the problem. But the thing to which I am going to call your attention for a few moments is the cost of all this. That is a vital question to be considered in every case with which we have to deal. Sooner or later it all comes down to a matter of dollars and cents, notwithstanding anything that you may accomplish in the laboratory. As soon as you get out and try to sell the apparatus you must answer what it will cost and how it is going to get through.

Now in all this planning for alternating current transmission, one thing has arisen in nearly every proposition, and this is the step-up and step-down transformation. In other words, it would seem to be a very convenient and economical procedure, in case we have a long distance to overcome, to put in a transformer at the generator and one at the motors, so as to be able to have a very small amount of copper in the line. Of course the gain is simply the gain that always results from using very high voltage, the saving of copper.

Now to come down to practical figures, let us see what these various things cost in the various methods that are employed. In the first case, that of direct supply, the generators are the only expensive things with which we have to deal aside from the motors which come in in every case. The principal expense outside of the generators is the line, and if the drop is permitted to be large the line expense need not be very heavy. But if we try to get along with a small drop the line expense will be very heavy.

Coming to the transformation methods, we have in the first place a direct current transformation; there we have to supply three sets of generators, whereas in the direct supply we had only one. In other words we have to supply the generator at the other end of the motor, and then a second generator for feeding the working motors. By that process we may be able to use a higher voltage on the line than would otherwise be practicable, and hence to get along with less copper. With the alternating system, if supplied in the same way with the motor generator, we also have the three generators. If applied direct as in the third case, simply a pair of transformers need be operated.

I suppose, on a fair average, the generators cost about $30 per horse power. The motors and secondary generators would cost about the same.

Now, as to the cost of the line, the cost of the copper will vary, of course, according to the voltage we use. The cost of the pole line is a factor that has too often been forgotten in the discussion, because, particularly when very high tensions are used, the cost of the pole line will be more than the cost of the copper, and it may reach a figure where the cost of the copper will play a very small part in the total cost.

In the first case, that of direct supply, we have the cost of $30, or thereabouts, per horse power. But this is not all. We have the cost of the line, both the pole line and the copper. Now the cost of the pole line, allowing, say 45 poles to the mile, set, will probably not be far from five dollars per pole. That is, counting from two to three dollars for the pole itself, and a little less than that amount for setting. Or at least that is the figure which is customary in railway work, and I think that applies rather generally, so that it actually comes in the cost of transmitting the power. Instead of having this uniform cost for any distance you have a cost that increases with very unpleasant rapidity. For each mile you go you will have to put in something like $250 for a pole line, so that the total expenditure will run up very rapidly indeed, for long distances.

Suppose we try the other process, that of using a motor generator. Here we have the initial cost of three machines. In other words, we have to put in nearly $100 per horse power for the machines. We will then start at about $90 per horse power as the initial cost of the machines alone. Then by using a higher potential, as can readily be done with synchronous alternators of very high potential direct current machines, you can save quite a little in copper. The pole line may still be a considerable figure; so that for each mile we will have to add quite a little for pole line. You may use rather lighter poles, and so on, but still we have the cost of the copper increasing with the distance. On the whole we have bettered ourselves from the fact that by raising the potential we do not need quite so much copper. It should be remembered that the cost of the pole line is nearly a fixed amount, whatever the horse power transmitted.

Now we will consider the case of the three phase system, or any similar alternating system. It may appear at first sight that the use of the step up transformer is going to help us a great deal. In case we do not step up we have an unknown cost for the line. The line, of course, is made up of two parts; in the first place the copper, and in the second place the pole line. Now, in any case where the copper is not particularly expensive and does not form a particularly large proportion of the whole cost, it probably will not pay to step up. In other words, it may very possibly happen that the cost of copper per kilowatt transmitted is less than the $30 which would be the cost of the transformers, and the distance to which you would be able to go before it would pay to step up is a considerable number of miles, more than one would suppose at first thought. For example we have the cost of the copper wire. You may take 00 copper wire costing about $300 per mile, or thereabouts, and supposing you step up so that you can use a No. 6 wire, then you will have to put in about $75 per mile. Now the difference between the two is not so formidable as might appear when you consider that instead simply of dealing with the copper you have in one case to deal with about $500 per mile and in the other case about $300, because you have to add the cost of the pole line also. So that it may very well happen that although you are able to use a small wire by stepping up, you are increasing the total cost, for the reason that you put in transformers, say at $30 a kilowatt, and you need not set up anything like that amount in wire. You will have to go quite a few miles before your extra cost of copper would equal the cost of the transformers.

Massachusetts Street Railway Statistics.

The second annual report of the Board of Railroad Commissioners of Massachusetts, just issued, gives some very interesting statistics in regard to street railways in that State. It is especially noteworthy on account of facts and figures given with reference to the West End street railway lines of Boston, the largest electric system in the country, and the one which has been held up as an example of the efficiency of the trolley system of rapid transit. The report summarized gives the following statistics for the year ending Sept. 30, 1891: Aggregate capital stock of all street railway companies, $19,553,952; gross debt, $11,656,815; total miles of track, 674.13; increase, 10.27; total cost per mile, $41,763; passengers carried, 176,090,189; increase, 11,205,746; average receipts per passenger, 5.06 cents; average cost, 4.05 cents; profit 1.01 cents against 1.10 cents the previous year. Number of accidents reported was 409, fatal 29. There were 204 accidents on the West End in the year ending Sept. 30, 14 of which were fatal; 122 accidents occurred by horse cars and 82 by electric cars. Sept. 30 there were in the State 279.44 miles of electric road using "overhead" system, increase 128.16, and 9.59 miles using storage battery, increase 6.50. There were under construction 13.3 miles of "overhead" system.

The Measurement of Insulation Resistance.

In the course of the discussion on two papers by Mr. W. H. Preece and Mr. Alexander Siemens, dealing with the subject of insulated electric light cables, Major Cardew exhibited before the Institution of Electrical Engineers (London) a method devised by him for testing insulation resistances. Major Cardew claims extreme rapidity and sensitiveness, together with accuracy, for his method; and, judging by the tests which he carried out before the members of the Institution, he can substantiate these claims pretty fully.

In Fig. 1 *E* is a Thomson electrometer, with the needle connected to earth, *V* is a Thomson "voltapile," *C* is the cable or other insulation resistance to be measured, *S* is the standard resistance which is balanced against *C*. Major Cardew uses for this resistance, *S*, either a special sort of

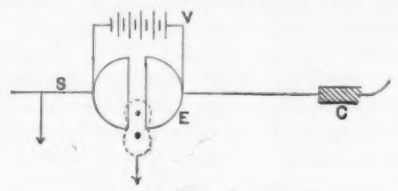


FIG. 1.

silk thread, giving under ordinary atmospheric conditions a resistance of several thousand megohms per inch, or an ordinary piece of silk thread with a somewhat lower resistance. The apparatus being connected up, as shown in the cut, all that has to be done is to unroll as much thread as will balance the resistance to be measured. Very high insulation resistances are in this way measured in a very short space of time. The insulation of the voltapile and electrometer must, of course, be of the very best, and Major Cardew says that he finds no difficulty in maintaining it at 1,000,000 megohms. The method being very sensitive, it would be desirable to know to what degree it is effected by variations of atmospheric moisture and the dampness or otherwise of the observer's hands as he unrolls the thread.

The same idea can be extended to the testing of central station leads. In Fig. 2, *D* is a dynamo, *M M* the mains, and *E* an electrometer. With matters arranged in this way so long as the insulation of the leads remains equally good

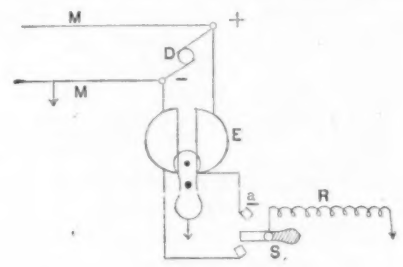
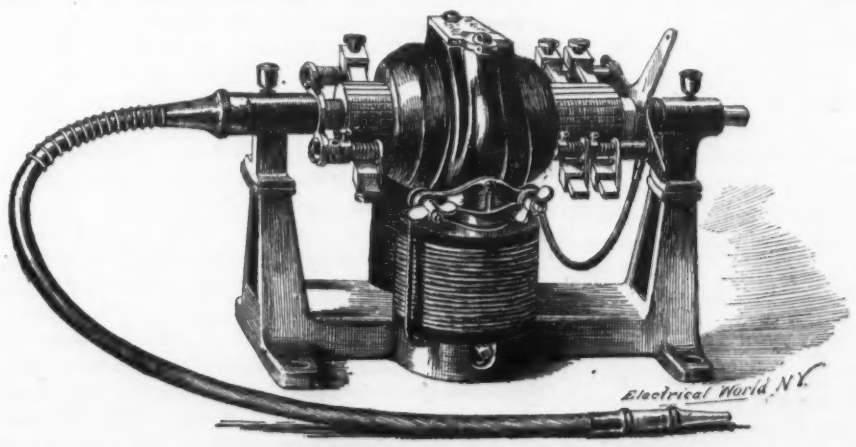


FIG. 2.

(or equally bad) there will be no deflection of the electrometer needle. Should, however, an earth occur, say on the negative conductor, then the needle will deflect to the right and *vice versâ*. If then it is considered desirable to determine exactly what is the resistance of the leak, we can turn the switch *S* to the right on to the contact *a* and manipulate the graphite resistance *R* until we get a balance, and *vice versâ*. Major Cardew suggests that hourly tests of the insulation might in this simple way be regularly carried out.

A Continuous Current Transformer.

A neat little machine, especially designed and built by the Crocker-Wheeler Electric Motor Company of this city, is shown in the accompanying illustration. It is a diminutive motor transformer constructed in the usual way with



CROCKER-WHEELER CONTINUOUS CURRENT TRANSFORMER.

two separate windings and two commutators upon its armature. One of the windings is for an electromotive force of 150 volts, while the other is designed for only four volts. The machine has been built to order for a doctor in New York City, who desired to use it for a variety of purposes and in a number of different ways, sometimes connecting the 150 volt terminals to the lighting circuit and utilizing in whatever way he pleased the low voltage current developed at the other terminals, and at other times driving the machine as a motor from a battery current connecting the high voltage terminals to a local lighting circuit. The speed of the machine is about 1,800 revolutions, and its rated capacity about one-sixth h. p. The illustration shows the machine with a dentist's drill connected to its armature shaft by a flexible coupling.

Lockwood's Trouble Register for Lighting and Railway Circuits.

There is perhaps no industry in which successful and satisfactory operation depends so largely upon prompt action on the part of managers in case of accidental interruption of the service as the business of electric light and power supply. The accidental extinguishing of one or a part of a whole set of arc lamps for even a few minutes may, and nearly always does, mean a serious loss not only of present but also of prospective business to the operating company. Similarly a temporary interruption for even a very brief period of the traffic on an electric railway line due to accidental breaking of the trolley line, or to some trouble with the feed wires, often causes great annoyance both to the company and its customers. In cases of this kind prompt action in looking after the repairs is of the greatest importance.

Whatever, then, will assist the operating company in locating any trouble on its lines ought to prove of much service. A simple set of instruments designed for this purpose and brought out by Mr. John Lockwood, of San

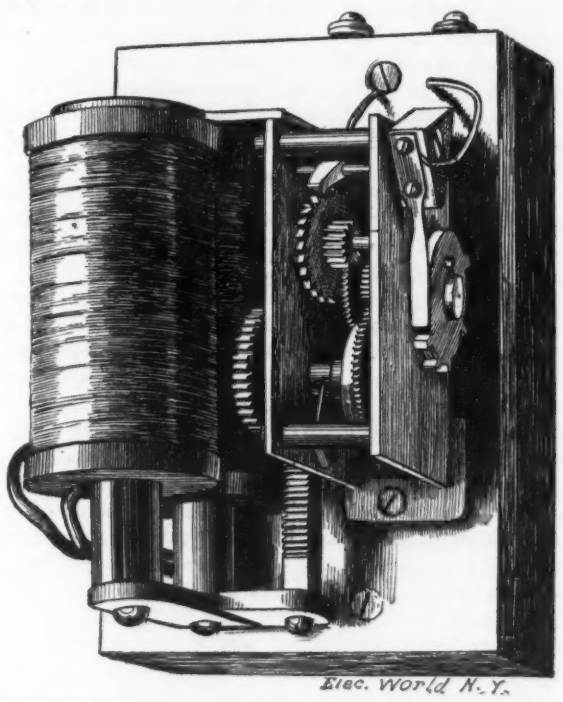


FIG.—1. LOCKWOOD'S TROUBLE REGISTER—SIGNALING INSTRUMENT.

Francisco, Cal., are shown in the accompanying illustrations, Figs. 1 and 2. They are intended for use on either electric railway lines or on arc or incandescent lighting circuits.

Fig. 1 shows the signaling instrument and Fig. 2 the recording instrument, the latter being placed in the manager's office, central station, or at the headquarters of the men who do the repairing. Whenever an electric railway line is divided into sections, as all the best constructed roads are or should be, the failure of any one section should be known as soon as possible at headquarters, so that repairing may be attended to at once and interruption on other sections of the line avoided. If an instrument like the one shown in Fig. 1 is placed upon each section of the line, the failure of the line will place it in operation instantly, and a signal will be sent to headquarters which will indicate upon the registering instrument, Fig. 2, the number of the section from which the signal is sent.

The operation of the signaling instrument is very simple indeed. The winding of the main magnet coils may be so placed in relation to the trolley line, or the feed wire, that whenever the current for any reason fails on the line the coils of the instrument will be demagnetized. It will appear from the cut that whenever the coils are magnetized the soft iron core will be drawn up into the coil. This action produces no movement of the mechanism of the instrument, but as soon as the current ceases flowing in these coils the core descends by gravity and puts in operation a simple clockwork very similar to the ordinary signal box, making a series of contacts which may be anything desired. In the instruments shown in the cut the combination of contacts is such that the number 113 would be recorded upon the tape of the receiving instrument. It will thus be seen that the instrument is entirely automatic in its operation, and that if the trouble which has set it in operation should be immediately removed, the instrument would again come into its normal position and be ready to record a second trouble should it occur. A very simple attachment to the instrument could be made so that the upward movement of the solenoid core would send a signal to the recording instrument which would indicate that the trouble had been removed and that the line was again in operation. The contact wheel, of the instrument is placed of course on one side, and the contact spring, which presses upon this wheel, upon the other side of a metallic circuit which runs along the line to all of the instruments, these being placed in multiple arc, all upon the same circuit. This forms a very simple and inexpensive system for an automatic registration of trouble upon the different parts of an electric railway system. At the receiving instrument a gong would be placed which would sound every time a signal from whatever source was sent in over the line, and the attendant upon consulting the recording tape would see at once where the trouble was and immediately take steps for its repair.

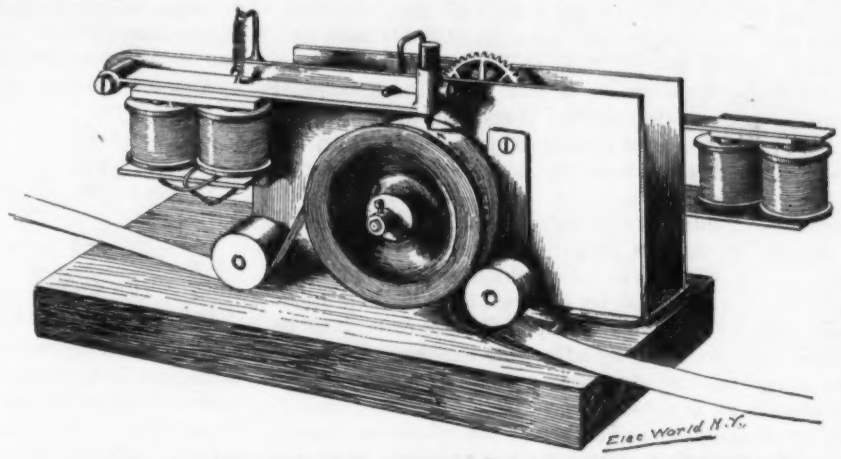


FIG. 2.—LOCKWOOD'S TROUBLE REGISTER—RECORDING INSTRUMENT.

The receiving instrument is also a very simple device and needs little explanation. The coils shown at the left of the instrument in Fig. 2 operate the pen or pencil which makes the record, while the coils upon the right merely release the clockwork mechanism which carries the tape under the pencil. The large wheel over which the tape passes can be made to turn one or one-half a revolution for each signal that is sent in.

This system of automatic trouble registration, it will be seen, is just as applicable to arc light circuits as to railway lines, and the same may be said of incandescent lighting and stationary motor circuits. All that is necessary is to place the instrument in circuit so that a failure of the line will withdraw from the coils of the instrument the current which holds the solenoid core in its upper position, and the signal from that box will be sent to the receiving station.

An Artificial Aurora.

BY T. B. HEIMSTREET.

An experiment showing "molecular bombardment" and the "aurora" may be made by rubbing an incandescent lamp on the clothing, or on paper, leather, sheet rubber or tin foil, when the bulb will become filled with light; if you stop it grows dark. If touched with the finger the filament and the interior will be a bright glow lasting from one to three seconds; if touched again, it is repeated; by drumming or drawing the finger slowly over the glass the light is quite continuous. If rubbed on newspaper in an absolutely dark room, the larger letters can be read at a distance of two or three inches. Fan the bulb with sheet rubber eight or ten inches away, but do not touch the glass, it will light the same quite bright if the fanning is very rapid.

The lamps used were the Edison 16 c. p., 20 and 22 volts. Most of the miniature lamps will give the light, but not all; the 110-volt store lamps will not.

It is evidently charged through the glass, as the glow will occur if the metal parts are enveloped in rubber. Everything used should of course be dry. It seems to be an electrophorus effect, the discharging only exhausting a section at a time.

Long Life of an Incandescent Lamp.

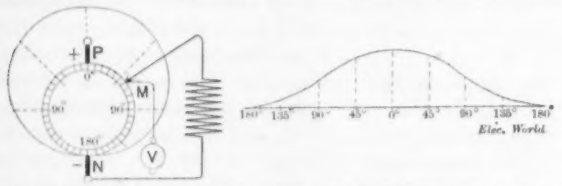
Mr. H. J. Wells, superintendent of the Osceola Light Company, Osceola, Pa., reports that a Sawyer-Man lamp on one of the circuits of that company has just closed a remarkable record. The lamp in question was constructed for an electromotive force of 110 volts and was run as nearly as possible at that voltage. Its normal brilliancy was 22 c. p. The lamp was placed in circuit Feb. 22, 1889, and remained in service with an average use of 8½ hours per day until March 5, 1892.

Notes on Electromagnetic Machinery.—III.*

BY WM. S. ALDRICH, M. E.

Electromagnetic reciprocating mechanisms form a class rapidly developing in application to work requiring controlled reciprocation with definite variations of the energy of the stroke. These two questions—the kinematics and the dynamics of this mechanism—have been met in what may be styled the multiple coil solenoid. It will be of interest to lead up to the form developed in the Van Depoele machine—from the electromagnetic point of view. The several steps do not always (in some cases very rarely) coincide with the evolution of the idea from its earliest inception in the mind of the inventor. But, examining how a given electromagnetic mechanism could have been evolved—finding how it came to be as it is—may be of service in the development of new forms, quite different in principle and application, yet worked out in more or less accord with the laws of kinematic synthesis; that is, the development of a machine for definite work and certain required motions.

Multiple-coil solenoid mechanisms require to be energized by currents of variable potential, producing variable and shifting magnetic fields of force, which may be caused to act in conjunction with or in opposition to each other. These potential variations in the respective coils may be produced and controlled by adjustable external resistances or by one or more rotating brushes around the commutator of a dynamo.† In either case, variable undulating (pulsating) or alternating currents may be produced from a source of constant potential. The loss of energy in adjustable resistance being very objectionable, the rotating brush mechanism is used—fulfilling the fundamental purpose. This is to convert the electrical energy of a continuous current machine rotating at its most efficient speed into undulating currents having any desired rapidity of succession, corresponding to the number of reciprocations of the plunger core working as a piston within the solenoid. The kinematic question is therefore met by fulfilling the conditions of comparative motion in mechanism (Willis)—the directional relation between the rotating brush and the reciprocating plunger, and their velocity ratio of movement. And it satisfies another condition stated by Reuleaux, in that the relative motion between the two elements is under con-

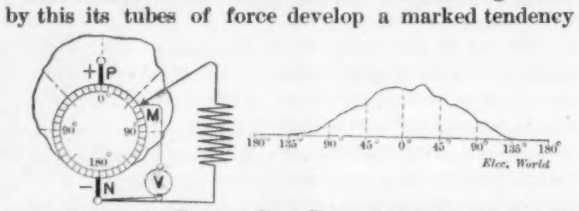


Figs. 1 and 2.—Single-Coil Solenoid Mechanism, with Ideal Integrated Curve of Potentials.

strainment, even if this is brought about by electromagnetic stresses in either medium, rather than by the molecular stresses of rigid connecting links of a kinematic chain. The mechanics of this mechanism—the statics and dynamics of its own peculiar medium for the transmission of energy—show that the electromagnetic forces of nature can be compelled to do work. And the ether medium with its induced electromagnetic stresses being as much a resistant body as more material mediums with their molecular resistance to change of form or of volume, constitute this combination an electromagnetic machine, from an adaptation of the definition of Reuleaux, given in the former paper. The tubes of force of the magnetic field may change their form to a very great degree, but they remain unaltered in volume; and it is the resistance of the tubes of force to any change of volume, which answers as well for the performance of work or the transmission of energy or motion as the resistance of a bar of rigid material to any alteration of its length or general form.‡ Also, examined in the light of Silvanus P. Thompson's treatment of electromagnetic mechanisms,§ the one under consideration possesses the characteristic feature that it is a combination in which power is transmitted electrically along a wire, and made to produce, through its electromagnetic combinations, certain mechanical motions.

The single coil pulsating current solenoid is shown in Fig. 1, diagrammatically, in combination with the rotating brush *M* and one terminal of the stationary brushes *N*, of the dynamo. What Silvanus P. Thompson has called the integrated curve of potentials, being the total or integrated potential taken at each bar all round the commutator (by the indicated voltmeter connection) has been plotted in its simple ideal form, around the commutator in Fig. 1, and as referred to rectangular co-ordinates in Fig. 2.

It is the line integral of the ideal (sine) curve of induction; and any ordinate represents the total induction from the fixed brush *N* up to that point of the rotating brush *M*. With the rotation of the brush *M*, there is produced a variation of potential through the solenoid coil, a corresponding undulation of current strength, and so a variation of ampère turns and a rise and fall of the intensity of magnetization of the solenoid core. This causes the plunger to be drawn into its coil with variable energy, according to the laws of the magnetic circuit, by which it continually so tends to place itself that it shall be in the field of maximum induction at any one time. The action is only in one direction—after reaching the maximum, at 180 degrees, the plunger gradually falls out of the coil by its own weight, or is retracted by a spring to its original position. If the rotating brush is held at any position around the commutator, the plunger will remain in its corresponding position for that point, being in more or less stable equilibrium between the electromagnetic stresses of the ether medium and the force of gravity or of a retracting spring. It would be possible to give a slight oscillation to the plunger in this position, as it is under the action of the contractile energy of the tubes of force, which is a property that the current has conferred on the ether medium surrounding the coils; by this its tubes of force develop a marked tendency to

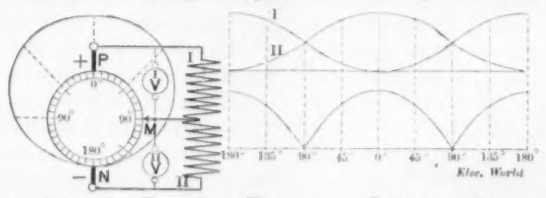


Figs. 3 and 4.—Single-Coil Electromagnetic Mechanism, with Real Integrated Curve of Potentials.

shorten in the direction of their length, and spread out in directions at right angles to their length. The integrated curve of potentials represents an entirely ideal condition of the cycle of operations, and does not indicate that the intensity of magnetization will proportionally vary in more than a quite general way. The several resistances in the path of the magnetic circuit—that of the air gap and of the iron portion—as well as the counter electromotive force dependent on the speed of reciprocation, and the movement of the plunger into and out of the field of force, will continually vary the resultant effect of the variable field of force. It becomes then rather difficult to plot exactly the real flow of magnetic stress along the corresponding positions of the plunger. It belongs to the class of intermittent mechanisms, and, like single-stroke devices, requires reactive forces to restore it to its original position. From the point of view of electromagnetic kinematics, it is a simple one-circuit (magnetic) mechanism, of constant direction (polarity) and variable intensity (of magnetization or of induction).

Figs. 3 and 4 show the real curves of the distribution of potential, taken with a voltmeter, as indicated, and with no other external circuit, from a small separately excited motor, run as a dynamo, with constant field.

The two-coil pulsating current solenoid has its outer terminals connected to the fixed brushes, *P* and *N*, as in Fig. 5, and the inner joint of the same coils to the rotating brush *M*. The resultant action of the two fields of force of the coils may be quite different (*a*) according to whether the two coils are connected up to operate in conjunction with each other, as two parts of one coil, called a differential coil-and-plunger mechanism by Silvanus P. Thompson, or (*b*), when the two coils are connected up in opposition to each other, producing variable electromagnetic stresses working against each other. In the former case the mutual actions of the two solenoid coils are reciprocal, the energizing effect of one of the coils increasing from zero to a maximum, while the other decreases from a maximum to zero, as the rotating brush is moved around the commutator a half turn, indicated in a general way by the ideal curves of integrated potential the upper curves of Fig. 6. This ideal cycle of operations being completed, shows two nodal points—positions of electromagnetic equilibrium—when the plunger is under the action of balanced electromagnetic stresses. This equilibrium is more or less stable, depending upon whether the two coils work with or against each other. The lower curves, Fig. 6, represent what may be termed the

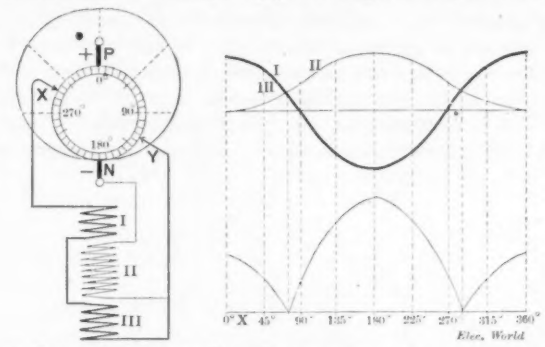


Figs. 5 and 6.—Two-Coil Pulsating Current Solenoid.

effective electromotive force, being found by taking the differences of corresponding ordinates of the upper curves. The portions between the nodal points are really of opposite sign, representing a reversal of the resultant effect of the variable magnetic fields. The plunger, on passing the nodal point, as a position of zero pull, goes more completely into the range of action of the increasing magnetic field and out of the decreasing field of the other coil. The combination of the two coils acting in conjunction results in an almost constant magnetization of the plunger, so that it has generally a steady pull and a regular movement, in which it follows the movement of the field of maximum induction of the solenoid coils, determined by the rotating brush *M*. It is a double-acting mechanism, giving two controlled reciprocations of the plunger for one rotation of the brush *M*. For producing hammer blows regulating switches may be used to vary the intensity of the magnetic field, according to the location and character of the work. The electromagnetic conversion of continuous circular into reciprocating rectilinear motion may be accomplished with equal facility and regularity, for almost any intervening distance, an advantage not possessed by its somewhat analogous mechanical (kinematical) equivalents of finite connecting rod, nor of the so-called infinite connecting rod.

Multiple coil pulsating current solenoids admit of varying the power stroke, as in hammer blows, to meet requirements of the work, while there is a very light return stroke to prevent excessive wear and tear of the machine. By winding the solenoid coils in three or more sections, of equal resistances, longitudinally disposed, and connecting the two or more forward sections in parallel with the supply wires and the back section singly, the current through this section will be correspondingly less than that through the other section with joint resistance in parallel.* This arrangement will therefore throw the preponderance of power in the forward stroke.

The three-coil pulsating and alternating current solenoid, with two rotating brushes, is shown in Fig. 7. Another and similar diagram† was explained at the close of the former paper. At the same time that there is a controlled reciprocation, the combination of the pulsating current through the fine wire coil *II*, with the alternating current through the coarse wire coils *I* and *III* gives a heavy power stroke in the forward direction and a light return stroke. Fig. 8 shows this in the form of the potential cycle, the light line curve *II* being the ideal curve of the integrated potential for the pulsating current of coil *II*, and the heavy line curve *I—III*, that for the alternating current coils *I—III*. The lower curve represents, as in Fig. 6, the differences of the corresponding ordinates of the upper curve. There are several peculiarities of the curves; and, though entirely ideal, may serve to aid us in forming some notion of the real distribution of electrical energy in the solenoid coils. The nodal points are both on the return stroke end of the plunger cylinder, encasing the mechanism. The long ordinate at the centre shows a very heavy power stroke forward, while the short ordinates at the ends show light return strokes with more or less of a cushioning effect. The action of the energizing polarizing coil *II*, shows how



Figs. 7 and 8.—Three-Coil Pulsating and Alternating Current Solenoid.

its pulsating current in the one case causes a very rapid increase of the resulting maximum induction, and in the other, at the end of the stroke, having no effect, as it simply rises and falls between zero and a maximum. The alternating current passes from maximum to maximum in opposite directions, and cuts the pulsating curve nearer the weak end of each case. The iron core, under the chief energizing coil *II*, is not electromagnetically equivalent to a permanent magnet core, for it is now variably energized in one direction, at about the proper points. But, in the latter case, its constant magnetic field would seriously interfere with this very arrangement of the two kinds of currents to produce maximum forward stroke. By reversing the connections of coil *II*, the other stroke will be a maximum. More than three coils may be used, and the respective positions of the pulsating and of the alternating current coils may be reversed, or otherwise arranged to suit the requirements of the work.

Derived mechanisms from multiple-coil solenoids admit of many industrial applications. For instance, it gives at once a kind of electromagnetic dash-pot, buffer, cushion, brake or clutch for reciprocating movements. And this possesses capabilities of adjustment not usually found in rigid or even fluctual-element mechanisms, of changing quickly and surely the intensity of the tractive force as well as the position of its static equilibrium. Periodically varying the speed of rotation of the brush *M* will result in corresponding variations in the rate of reciprocation, with or without changing length of stroke. The length of stroke may be changed by auxiliary and solenoid coils. On the other hand, the speed relations may be maintained constant, and the power stroke varied at will, or both may be varied to any desirable extent. Another modification, which would produce multiple nodal points, would give multiple reciprocation mechanism (reduplication of Willis), obtaining four, eight, or more reciprocations for one rotation. For the stress nodal points indicate the electromagnet dead centres, of which there must be as many as the number of reciprocations desired. So with electromagnetic cams—the stroke of the plunger may be made to follow any given law of cam curves or spirals, as the Archimedian or logarithmic, by simply controlling the rotating brush *M*, according to the same law. And the stop, dead and change points of ordinary cam plates may be controlled with equal facility by this electromagnetic combination. Electromagnetic ratchet mechanisms, where there is no special return or reversal of motion, may be equally

* A paper read before the Electrical Section of the Franklin Institute. For the first and second sections of this paper see The Electrical World of Feb. 13 and Feb. 27, 1892.

† As in the Van Depoele pulsating electric generator, United States Patent No. 422,855, March 4, 1890.

‡ Compare Rankine, "Machinery and Millwork," chap. iv., sec. viii., art. 207; Thurston, Introduction to "Kinematics of Machinery," Van Nostrand's Science Series, No. 54, p. xi.; Kennedy, "Mechanics of Machinery," chap. i., sec. 1.

§ The Electrical World, 1891, Jan. 17; also, in his work on "The Electromagnet."

* Van Depoele's method, set forth in United States Patent No. 422,855, March 4, 1890.

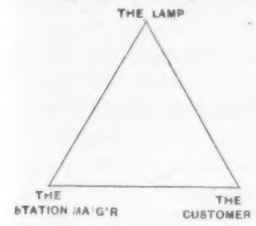
† From *The Electrician* (London), vol. xxviii., Nov. 6, 1891, p. 10.

developed from the solenoid mechanism, chiefly of the multiple-coil types, with the coils connected up in series, as in the portelectric and other electromagnetic package carrying devices.

"The Lamp," the "Electric Light Station Manager" and the "Customer."*

BY E. P. ROBERTS.

It will be noticed that my paper is headed with a triangle having "The Lamp" at the apex, and at the lower angles "The Electric Light Station Manager" and "The Customer," the latter term being used to signify the person who pays for the light, whether he pays for the lamp directly or indirectly.



I had at first thought of heading the paper with a figure of a lamp, and from it radiating three lines—marked as shown in Fig. 1. It has, possibly, a more artistic effect than the device chosen, but, as I looked at it, the idea presented itself that it was symbolical of three forces pulling in different directions, and that such was too much the actual fact. Therefore I chose a figure which symbolizes a closed circuit of strains and stresses. It indicates that the three factors are mutually dependent, and none can

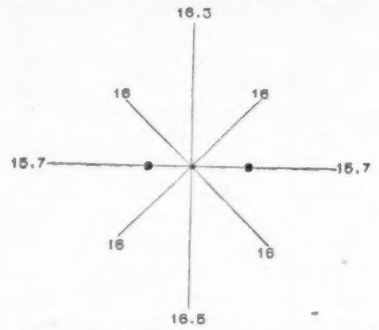


FIG. 3.—CANDLE POWER AT DIFFERENT ANGLES.

exist without the presence of the others. Such being the case, it is certainly wisdom that they should be well acquainted with each other's peculiarities, and it is not sensible to endeavor to hide anything because it is short of perfection. If it be attempted, the fall from an unwarranted elevation may bring utter ruin, whereas, if the failings are accepted, because of the great benefits otherwise unobtainable, there is no fall, as the article is already on the proper level.

First, We will inquire as to what is desired by each of the three factors.

Second, We will investigate as to how nearly the desire can be satisfied.

As any one who studies mechanism is sure, if he really be a mechanician, to give the product of his brain a personality, we will speak of the lamp as though it had desires of its own, which when allowed to govern enable it to do its life work as intended by its creator, but when overruled

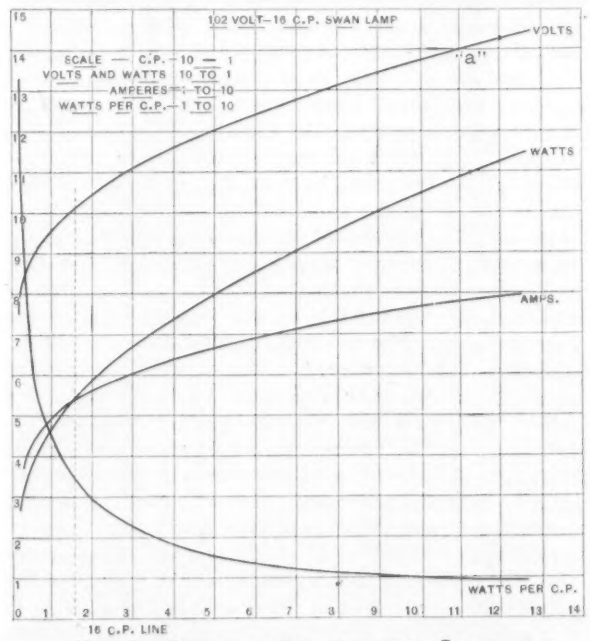


FIG. 2.—CURVES OF INCANDESCENT LAMPS.

disaster follows. This being the case, "The Lamp" desires to be understood.

The customer wants a lamp which will consume little energy, provided the energy is metered, as eventually it always will be; will maintain its original candle power at constant voltage during its life, and will have a long life. If he pays for lamp renewals he wants a cheap lamp.

The electric light station manager wants a lamp which will have the characteristics above mentioned, and will never be broken, either in transit to the electric light company, or in transit from the company to the customer; all apparently a matter of "transit" to some managers, when making claims against the lamp, whether it be carried in a lineman's pocket or otherwise—and he also wants a lamp that will stand screwing into a socket by means of a pipe tongs.

* A paper read before the Engineers' Club, of Cleveland.

To what extent does the lamp of the present day fulfil the modest requirements.

It is not necessary to tell you what a glorious thing an incandescent electric lamp is, nor is it advisable to go into its history; as to the first, its advantages are well understood; as to the second, recent patent litigation has furnished a mass from which any one can take his choice, or can deduce a new history of his own.

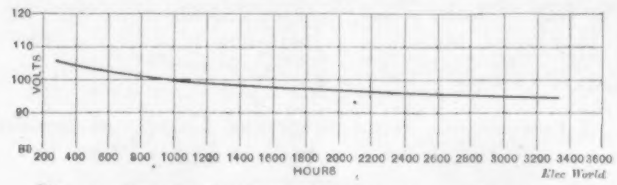


FIG. 6.—CURVES SHOWING VARIATION OF LIFE WITH VOLTAGE.

Therefore, taking it as granted that the superiority of the incandescent electric lamp over all other methods of artificial illumination of interiors is well understood, we will examine the lamp in detail to the extent necessary to furnish the character of information desired by an intelligent customer. How a lamp is made he cares not, provided the results are good.

At the present time lamps are made with much higher initial efficiency, average efficiency and life, than those made a few years ago. The price is also one-half, or less. The mechanical finish and general proportions are usually excellent, and the breakage in transit small. With reference to the last item, it is a curious fact that the shippers of bulbs to the lamp manufacturers, in common with all glass makers, state to the lamp company superintendent that he must expect a breakage of five per cent. in transit,

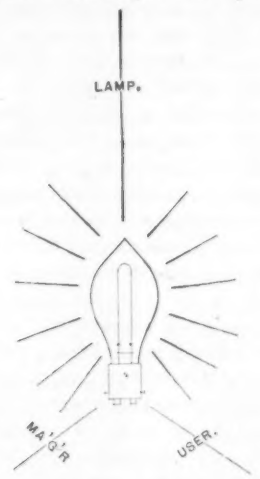


FIG. 1.—THREE FACTORS IN THE LIGHTING BUSINESS.

and that anything less is fortunate. For anything more they blame the railway company. On the other hand, the customer expects, or rather claims as a right, "no breakage," and also objects to the weight of the package. To the man *in between* it seems, let us say, curious. Even with all the improvements lamps are not yet perfect. They still consume energy, they will give out in time, they will not maintain their candle power at the original voltage during their whole life, and they can be broken by very rough handling.

First, with reference to the candle power of a lamp. Evidently it is not the same at all angles, but for commercial comparison it is, in most cases, quite sufficient to take

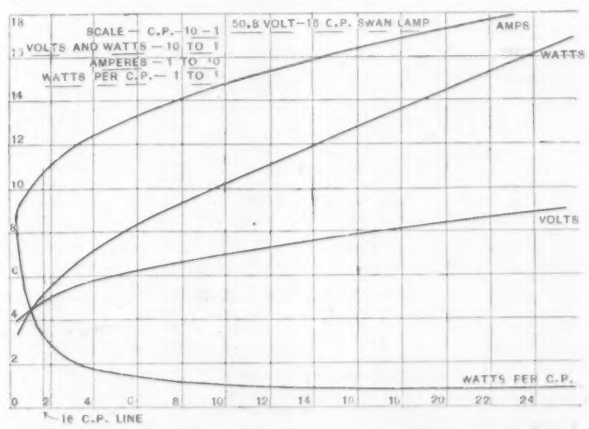


FIG. 5.—CURVES OF INCANDESCENT LAMPS.

the mean horizontal candle power. This is obtained by measuring the candle power around the horizon and taking the mean. For the lamp whose curve is platted in Fig. 2 the relation of candle power to position is shown in Fig. 3, the point at which it gave 16 c. p. being 45 degrees, and the candle power at 0 degree and 90 degrees being as shown, and the plane of the filament being indicated by the small black circles. The voltage necessary to give 16 c. p. at other points is shown in Fig. 4.

Curve *a* of Fig. 2 shows the relation of candle power to voltage for a 102 volt 16 c. p. lamp and curves *b* and *c* the relation of current and watts to voltage, and, therefore, candle power for the same lamp. In Fig. 5, curves *a*, *b* and *c* are similar curves for a 51 volt 16 c. p. lamp. Evidently a lamp can be made which will not consume much energy per candle power. Why are not the best results as shown above obtained in practice? The answer is because the life is shortened.

Fig. 6 shows the effect of various voltages upon the life of a 100 volt 16 c. p. lamp. This curve is plotted from figures given in a pamphlet issued by the Edison company. According to the curve, a lamp lasting 1,000 hours at 100 volts will last a greater or less time at other voltages to the extent indicated. It is the result claimed to have been obtained by burning many hundreds of lamps in the laboratory, with the greatest care to keep the conditions constant. The tests were made some time ago, and lamps have improved since then. On the other hand, lamps are now operated at a higher initial efficiency than formerly, and therefore the results are probably not far from correct. Accepting such as a fact, I am sure that the importance of maintaining a constant voltage, if life is desired, will make itself very evident by a study of the curve. A lamp at 100 volts which would last 1,000 hours, if at 102 volts will last only 600 hours, and at 106 volts only 233 hours. Regulation within 3 per cent. at all times is much better than the average.

Fig. 7 gives the comparative life of lamps designed to operate at different initial efficiencies. This curve, Fig. 7, is taken from a paper entitled "Maximum Efficiency of Incandescent Lamps," by John W. Howell, and read April 14, 1888, before the American Institute of Electrical Engineers. Mr. Howell is well known as an authority on the

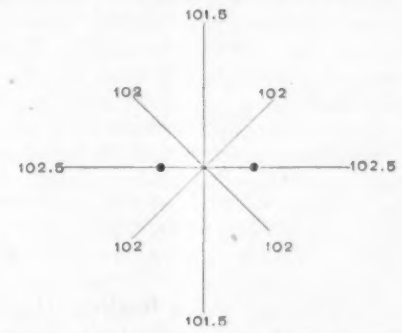


FIG. 4.—VOLTAGE NECESSARY FOR 16 C. P. AT DIFFERENT ANGLES.

incandescent electric lamp, and, in the above article, he shows that the maximum economy in station operation is reached when the lamp costs 15 per cent. of the operating expenses. According to his figures, when the lamp bill is more, less efficient lamps should be used; when less, a more efficient lamp, having shorter life, will give the minimum total cost of operation. Of course when customers buy their own lamps, the more efficient the lamp the better for the producer of current; evidently so if on a "per lamp" contract basis and just as truly so if on a meter basis.

The next point to consider is the average efficiency of the lamp, in other words, "How much does the lamp drop off when in use?"

Mr. William H. Peirce read a paper before the American Institute of Electrical Engineers, June 8, 1889, upon this subject. From his experiments, which were unfortunately with too few lamps to be more than indicative, he concluded that the lamps which he obtained showed very considerably higher *average* efficiency when made of low *initial* efficiency. In other words, that the average candle power per watt of the lamp with *low* was greater than for lamps of *high* initial efficiency. Lamps have improved since his tests were made, but the general fact remains as then. However, there is a demand, and it is a legitimate one, for lamps of higher initial efficiency than four watts per candle power, which has been a very common actual initial efficiency for all lamps in recent times; and lamps are now made of from 3.1 to 3.75 watts per candle power for 16 candle power lamps. Which limit it is advisable to approach, the lamps in either case being equally well made, depends upon the cost of power and the cost of the lamp. As the price of the lamp drops it is, evidently, economy to use a more efficient lamp even at the expense of life, provided it is not carried to such an extent

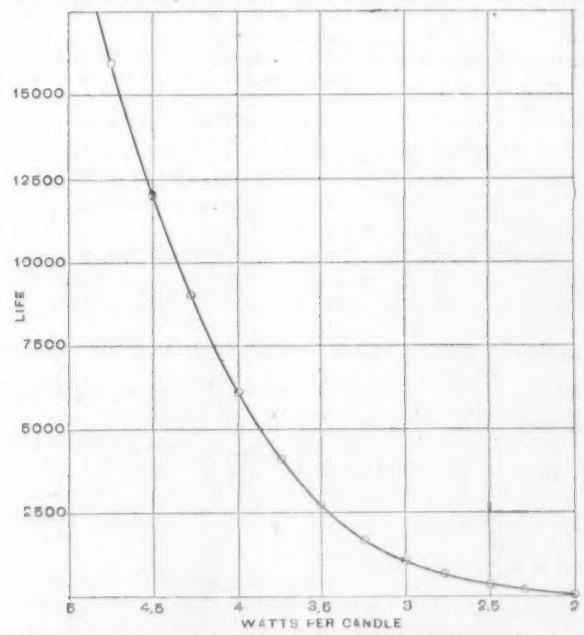


FIG. 7.—COMPARATIVE LIFE OF INCANDESCENT LAMPS DESIGNED FOR DIFFERENT CURRENTS.

as to make renewals an annoyance, although theoretically the greatest economy is thereby obtained. Practical considerations must not be lost sight of when following deductions from theory, or from the ledger, or deductions from the receipts will result.

The term "efficiency" has here been used in its usual signification in lamp work, that is, as expressing the relation between energy furnished the lamp and the amount of light emitted which would appear to be equivalent to a certain number of standard candles when measured in the ordinary forms of photometer. The real efficiency of a source of light is the relation between the energy consumed by the lamp and that given out as light. The last factor is determined by measuring the energy given out as heat, the difference between such amount and the total energy furnished is light, and amounts to from three per cent. to seven per cent., according to the degree of incandescence. This branch of the study of the lamp is very interesting. Prof. E. L. Nichols has done much to help the electrical engineer in this line, as in others, and most of his work has appeared in the *Transactions* of the American Institute of Electrical Engineers and in the technical papers. His paper on "The Efficiency of Methods of Artificial Illumination" * is especially valuable in this connection.

One point has been left to the last. It is *cost*. It is getting to be more and more the custom for the user of the energy to supply his own lamps, the electric light station merely furnishing energy and charging by meter. This is as it should be. The cost may be considered either as the cost per lamp of the standard desired, usually 16 c. p., or may be taken as the cost per candle power, higher candle power not costing proportionately more for lamps and, up to 50 c. p., usually no more for fittings; but of course extra for wire and fuse fittings of greater capacity. In any case the cheaper the lamp the better for the consumer and for the station manager. The less the total outlay for the purpose of obtaining light the more freely it will be used. The electric light station manager should do the same as the gas company does, bring the supply to the premises of the consumer, install, after being protected by a deposit, a meter, then furnish current and do nothing more. Every one, except the stockholders, considers a corporation furnishing light as a band of robbers, and, for the company's sake, the less it has to do with wiring, furnishing lamps, etc., beyond inspection, the better. The day when such a course is generally practicable has not arrived, but is, I believe, coming.

A résumé may be given as follows:

The lamp should be { Efficient, Long lived, Cheap, Strong, Mechanically perfect. } { The interrelations of these factors being dependent upon cost of power.

The electric light station manager should { know what he wants, get what he needs, use it as designed

The customer should { Understand that a lamp will not last forever or hold up its candle power any more than a gas burner will. Therefore take breakage and deterioration of lamp as an evil incident to, although overshadowed by, the great attendant benefits.

As it is often desirable to know how much resistance to insert in series with an incandescent lamp in order to bring it to a desired candle power, it may be of assistance to show how to calculate such amount.

By looking at Figs. 2 and 5 the voltage for any candle power for a 50 or 100 volt, 16 candle power lamp can be obtained and also the current taken. Then insert the data in the formula for Ohm's law, $R = \frac{E}{C}$ and the R is obtained, and by referring to tables of carrying capacity the proper size of wire is chosen.

For example—A bank of 20, 100 volt, 16 candle power lamps are to be reduced to 6 candle power each. The voltage for 6 candle power = 87. The loss = 13 volts. C for 6 candle power, $49 \times 20 = 9.8$ ampères. Therefore $R = \frac{13}{9.8} = 1.3$ ohms.

Using† { Iron wire, wood frames = .092 mils D. and 119' long. Iron wire, iron frames = .080 mils D., and 90' long. German silver = .102 miles D. and 80' long.

Current Water-Wheels.

For many years the problem of constructing a water-wheel for driving steady power, utilizing the natural current of streams, has brought out many current water-wheels which have been placed on the market, owing to many advantages to be found in this form of wheel, but not until recently, it is claimed, has a wheel been brought out which would do the required work. A short time since a prize was offered at Buffalo, N. Y., to the inventor of the best current water-wheel. From the many designs shown a new current wheel, which is being placed upon the market by the John E. Beggs Machinery and Supply Company, of 74 Cortlandt street, New York, received the first prize. Since then preparations have been made to place it in general use.

Water power under the most favorable circumstances has been very unsatisfactory as a driving power for electrical machinery. But it is claimed that this new current water wheel has entirely overcome the objectionable feature of "want of steady power," and the manufacturers state that they do not hesitate in guaranteeing it under almost any reasonable conditions for driving electrical machinery.

* See THE ELECTRICAL WORLD, March 30, 1889.
† Herrick, THE ELECTRICAL WORLD, April 5, 1890.

A Comparative Test of High and Low Speed Engines for Use in Electric Railway Power Plants.*

BY CHAS. W. WASON.

Having high speed and Corliss engines in our power house, I thought it of sufficient interest to make some comparative tests relative to the economy of the two types of engines. A brief description of our plant may not be out of place. Three Armington & Sims engines 14½ inches by 15 inches, and three others, 18½ inches by 18 inches, of the same make, compose the high speed portion of our power plant. To each small engine are belted two Edison generators of 40,000 watt capacity, and to each large engine are belted two 800,000 watt generators, manufactured by the same company. In the other part are two 28 inch by 48 inch simple Corliss engines, made by the C. & G. Cooper company, belted to a countershaft seven inches in diameter and about 80 feet long, with four clutch pulleys 88 inches in diameter by 28 inches face made by the Hill Clutch Works, and from the countershaft are belted four 175,000 watt Edison generators. Our steam plant consists of 14 tubular boilers, 18 feet long, 72 inches in diameter, with 72 four-inch tubes with Murphy settings. We have been able to use the same boilers in each test, selecting those that would equalize the distance the steam was carried in each test. Laboring under the disadvantage of not having an ampère meter of sufficient capacity to carry the entire current, we were obliged to station a man to read the individual ampère meters of each machine, these men taking the ampères upon the sounding of a gong every 15 seconds. The water used for steam passing through a meter, it was an easy matter to determine the quantity used during the 10 hours. Each wheelbarrow of coal thrown on the floor was weighed, so that we knew the number of tons burned. An accurate account of the number of motors and tow cars moved and mileage made by each was kept. Hourly readings of the thermometer were taken, and the condition of the weather noted. We used an automatic steam registering gauge. The temperature of the water as it left the Berryman heaters was taken every 15 minutes, also as it ran from the street main. By taking readings of the quantity and pressure of the current every 15 seconds, or, in other words, 2,400 readings in 10 hours, a very fair average of the electrical output has been obtained. Owing to the constant and rapidly varying load, it is about impossible to get the mechanical horse power. In taking a card with the indicator the load will change before the stroke is completed. I would very much like to hear from any one who has a device that will accomplish this purpose. I expected to find a greater difference in favor of the low speed over the high speed. Of course we have the countershaft to run in the former, and this load does not come in on the latter, giving in turn a factor of flexibility that is of importance.

The following is the data of tests taken Feb. 14, with high speed, and Feb. 21, slow speed plant:

	Feb. 14.	Feb. 21.
Av. electrical h. p. developed in 10 hours	563	630
Max. electrical h. p. developed in 10 hours.	813	842
Min. electrical h. p. developed in 10 hours.	486	354
Number gallons oil used in 10 hours	7 gallons.	8 gallons.
Water consumption for 10 hours	3,900 cu. ft.	3,800 cu. ft.
" " per av. elec. h.p. per hr.	43.29	37.69
" evaporated per lb. coal per hour	6.61 lbs.	6.54 lbs.
Bituminous slack coal used in 10 hours	36,900	36,300
Ashes made in 10 hours	4,890	4,779
Fuel used per av. elec. h. p. per hour	6.55 lbs.	5.76 lbs.
Combustible used per av. elec. h. p. per hour	5.68 lbs.	5.00 lbs.
Pounds of coal per car mile	6.57 lbs.	6.38 lbs.
Average ampères per 10 hours	812	907
Maximum " " "	1,120	1,160
Minimum " " "	720	720
Average voltage " "	518	518
Maximum " " "	535	530
Minimum " " "	505	510
Number of readings of 15 seconds intervals.	2,385	2,395
Av. temperature of water from heaters	186° F.	197° F.
" " " street main	39° F.	29° F.
" " the outside atmosphere	43° F.	41° F.
Condition of weather	Rainy.	Foggy.
Av. steam pressure	96 lbs.	97 lbs.
Maximum steam pressure	102 lbs.	100 lbs.
Minimum " "	90 lbs.	90 lbs.
Average chimney draught	⅞ in.	1⅛ in.
Number of motor cars run on the line	62	62
" tow cars run on line	9	10
" miles made by motor cars	4,640.02	4,627.39
" " " tow cars	767.65	806.53
" passengers carried on cars	12,366	15,462
" miles made by Brooklyn motor cars	61.75	87.28
Number miles made by Brooklyn tow cars.	30.87	43.64
" " " Broadway motor cars	117.10	117.10
Number of Brooklyn motor cars	4	4
" " " tow cars	2	2
" " Broadway motor cars	5	5
" " " tow cars	None.	None.
Total number of motor car miles	4,818.87	4,831.87
" " tow car miles	798.52	850.15
" " motor cars	71	71
" " tow cars	11	12
" " motor and tow cars	82	83
" " car miles made from power developed	5,617.39	5,681.94
Average horse power per car	6.86 h. p.	7.59 h. p.

* Fifty-four of these are No. 6, and seven are No. 14 Edison, with one Thomson-Houston "S. R. G.," 15 h. p.

*A paper read before the Cleveland Electric Club.

The Siemens & Halske Electric Company, of America.

The announcement which was made some time since that the Siemens & Halske company, of Berlin, Germany, had decided to establish a large manufacturing branch in this country, was followed by the recent incorporation of the Siemens & Halske Electric Company, of America, with headquarters in Chicago. The personnel of the new company is as follows: O. W. Meysenburg, president; A. W. Wright, secretary; directors, Arnold von Siemens, George William von Siemens, O. W. Meysenburg, A. W. Wright and Alexander von Babo.

Considerable interest has been awakened among the various American companies by the incorporation of the new company, and much importance is attached to the statements which its members have made in regard to its future plans. It is conceded by many prominent in electrical interests that the time is very opportune for the new company to start in for its share of business in the electrical field in this country and that the electrical business generally will be benefited by the competition, as it is admitted that the new company will be a formidable rival. The incorporation of the new company, it is stated, was brought about from the fact that negotiations between representatives of the Siemens & Halske company, of Berlin, and the World's Fair Exposition authorities were not entirely satisfactory, and did not permit of such an exhibit as the company desired to make. While these negotiations were pending, prominent members of the European company visited this country, and taking into consideration important developments in the electrical field decided that they were justified in starting a branch establishment in America, which resulted in the filing of the articles of incorporation of the new company, note of which appeared in THE ELECTRICAL WORLD of March 12. The parent company is one of the most extensive and richest abroad, and the new company will be backed, as it develops, by all the experience and money that the business will demand.

Mr. George H. Benjamin, of 35 Wall street, this city, is acting as the legal representative in this country of the Siemens & Halske company, of Berlin, and also of the Siemens & Halske Electric Company, of America, the new organization. To a representative of THE ELECTRICAL WORLD Mr. Benjamin said last week that the company would start out with a capital consisting of $500,000, which had been placed in trust, and that this capitalization would be increased in accordance with the demands of the business. Operations will begin at once, and the first factory is to be located in connection with the shops of the Wells-French company at Blue Island avenue and Paulina street, Chicago. The site has already been selected, and plans are being drawn for the permanent plant and the town which will be built up around it. This latter will be similar to the well known city built around the shops of the Pullman car works just outside the city limits of Chicago. Houses are to be built for the employés of the company, and the entire establishment is to be run on the co-operative plan, the employés sharing in the profits of the business in a similar way to that now practiced by the European house of the Siemens & Halske Company. It is intended to begin operations on a comparatively small basis, but with plans drawn for a contemplated growth to a very large capacity.

In reply to an inquiry as to whether the company would build American machinery or undertake the manufacture of German apparatus for the American market, Mr. Benjamin said that the machinery would be in every sense of the word American and built for American service in accordance with the demands of the American customer. One of the principal features of the business will be the extensive manufacture of heavy machinery, especially of dynamos and motors ranging in capacities from 500 to 1,000 h. p. The company will not take up the manufacture of incandescent lamps. The new organization does not intend to come into this country for the purpose of disastrous competition with any concern, does not intend to cut prices, and does not propose to be a pirate or a fighter among the manufacturing concerns already doing business. Some very extensive work is contemplated in plants for the transmission of power, a field in which the German company has already done a very large amount of useful work. It will build a large number of experimental plants of different kinds, especially one in which the three-phase system will be used. It is proposed to enter the field as a manufacturing corporation strictly and not an exploiting one. The manufacture of submarine cables may be taken up on a large scale. Fine testing instruments will be manufactured, a line of apparatus for which the company has already become famous. Should any railway company desire to introduce the Siemens-Halske underground system similar to that of the Buda-Pesth line in Germany, the company will assist in its introduction by furnishing plans, but it is not proposed to make a specialty of this branch of the business.

Mr. Benjamin said that there was no truth whatever in the rumor that the new company was to form a combination with the Westinghouse company, or with any other company; that the new organization intended to do business as an independent concern and that it had already refused overtures to join the Thomson-Houston-Edison consolidation, and the fact that its capitalization, $500,000, had been placed in trust, that there was no stock issued or for sale, precluded any possibility of consolidation with other companies.

The company proposes to establish a business which, while it is strictly American, will embody in the products of its factory the results which have been obtained by the long experience of the Siemens & Halske company in Germany. The German firm took out patents in this country in 1878, and has in all some 35 issued patents, besides a large number already pending, and it is stated these patents will permit the manufacture in this country of any or all of the Siemens & Halske apparatus.

It is evident that the new company means business, and will enter the field to secure a portion of the electrical trade in a territory in which future developments will be enormous, and it is predicted that the Siemens & Halske Electrical Company of America, starting in apparently under most auspicious circumstances, will be a factor second to none in this country.

Artistic Arc Lighting.

BY DR. GRAHAM SCOTT.

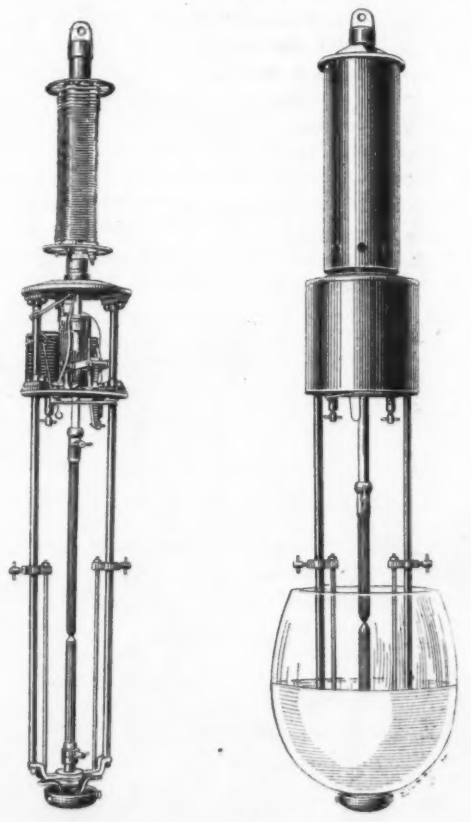
It is conceded by all that for purposes of illumination the electric light is superior to every other illuminant. In the infancy of man's advent and for many ages the bonfire made by the pre-Adamite's rapid friction of two sticks fitted every requirement of that rude age. The Assyrians, Chaldeans, etc., became somewhat more æsthetic, and the requirements of luxury brought forth the absorbent thread or wick of vegetable or other fibre dipped in the clam shell or pottery urn. It was reserved for the more æsthetic Greeks of Pericles' time to combine beauty with utility, and we are all familiar with the ornate flambeaux, cressets and urns for shedding forth the Promethean flame, still extant and brought to the view of modern people by the labors of Di Cesnola and Schliemann.

We all remember the lard and sperm lamps of 50 years ago, and smile at the feeble artistic attempts of our forefathers of the days when whalers from New Bedford and Medford were both numerous and thrifty.

Then the gorgeous and brassy pendants and chains of the old fashioned fluid and camphene lamps, which seemed the acme of perfection in the forties, were they not a glory to behold?

Since the use of illuminating gas became general chandelier makers have developed wondrous creations and things of beauty in the way of gasoliers.

When the electric light was made commercially possible by the cheap generation of electricity, municipalities and peoples cried so fervently, "Let us have light!" that Jablochkoff's candle of carbon rods and other crude forms of lamps which gave the electric glow were hailed as all that was wanted, and so great has been the growing demand—many millions of not only arc but also of incandescent lamps being now in constant use—that electric light com-



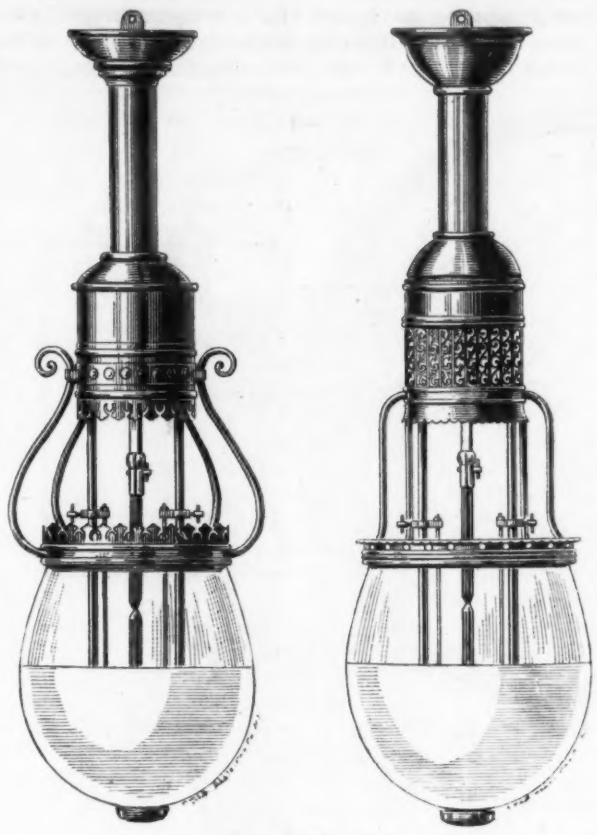
FIGS. 1 AND 2.—THE SCOTT ARC LAMPS.

panies have had all they could do to meet the demand for increased light without having time to think of the æsthetic in arc lamps or electroliers. Now that the first flush of novelty is over, the patrons of the electric companies begin to demand not only utility but beauty, and while a great deal has been done in an artistic way with incandescent bulbs, most of the large gas chandelier makers having turned their skill and factories into the fabrication of "things of beauty and joys forever" in the way of electroliers, nothing of any moment has been yet done toward making the arc lamp a pleasant and beautiful object.

The Scott Electrical Manufacturing Company, of New York, has departed from the beaten path and has determined to hide from the eye all of the hideousness and angularity of arc lamps. They are manufacturing covers, hoods and crowns, finished in the highest style of the chandelier maker's art, after truly artistic designs, which will convert these monstrous plagues to the æsthetic sense into objects of magnificently chaste beauty.

These artistic arc lamps will be used in hotel offices, about large public and private buildings, in the foyers, vestibules and entrances to theatres and other places of amusement, in and about railway stations and buildings, etc.

The Scott Electrical Company has already made numerous contracts to place a number of the "Rushmore multiple



FIGS. 3 AND 4.—THE SCOTT ARC LAMPS.

series arc lamps" in the principal hotels and theatres in many of the larger cities of our country. We show on this page some of the many artistic designs from the portfolio of the artist of the Scott company.

The economy of current and increased illumination obtained by using multiple-series lamps on incandescent circuits commends this system of combining arc lamps and incandescent bulbs on the same circuit.

In large buildings, as railway stations, stores, public halls, docks, etc., it is necessary and desirable to have incandescent bulbs in offices, over desks, etc., but in the larger waiting rooms, railway stations, stores, billiard rooms, dining rooms of hotels, restaurants, etc., the increased illumination obtainable with the same number of ampères in arc lamps is of decided advantage. Each 16 c. p. incandescent lamp requires, let us say, ½ an ampère. In a room illuminated with fifty 16-c. p. lights consuming 25 ampères, the total candle-power is 800.

The same 25 ampères used in arc lamps would give over six times as much light as could be obtained with incandescent lamps consuming equal ampères. Twenty-five ampères divided among three arc lamps of eight ampères each, or two arc lamps of 12½ ampères each, would give 5,000 c. p., as against 800.

The multiple series lamps made by the Scott company are thoroughly mechanical, electrical and scientific in principle and construction. They are synchronous in feed and can be regulated to burn eight or fourteen hours, according to the grade and cross-section of carbons used. They cast the minimum amount of shadow and give a beautifully white light, free from flickering. By this company's system of filtration through media the electric light of the powerful arc lamp can be so toned that all objections to its indoor use are overcome, as in public halls, theatres, hotel offices, dining rooms and restaurants. This system overcomes the violet and ultra-violet rays, which are so objectionable.

The writer had the honor of being a guest of the Massachusetts Electrical Engineers and Mechanics' Association, of Boston, at the second annual ball given by that association at Oddfellow's Hall, on the night of Feb. 2, 1892. The electric decorations and lighting of the ball room on that occasion exceeded anything which has ever been attempted in this line. The grand results represented the work of 100 men for one day and reflected the highest credit on the artists who did it. Ben Franklin's kite in incandescents at the dome of the hall represented the work of 25 men for one day. Edison's name in variegated bulbs represented the work of an equal number of men for the same time. The horologue which told the hours all too quickly was wreathed in dazzling incandescents. Red, white, blue and amber bulbs were strung on radiating festoons of bunting. The grand old Star Spangled Banner was incrusted with brilliant and shimmering stars. Two electro-calciums, donated for the occasion by the Scott Electrical Company, were arranged in opposite corners of the ballroom, and when the dances were in progress colored sheets of gelatine were placed in front of the lamps, the effect produced being a very brilliant one.

The Ries Regulating Socket for Incandescent Lamps.

The exhibition of the Ries regulating socket for incandescent lamps at the recent convention of the National Electric Light Association attracted so much attention that a brief description of its construction may prove of interest to our readers. The apparatus is intended to provide means for gradually varying the intensity of the light emitted by a lamp as well as for extinguishing the light altogether, and to obtain this result in an appliance that is at the same time small and compact and permits of a wide range of regulation. The lamp socket is provided with an annular core wound with a number of lengths of insulating wire arranged in the form of a strand or cable, the ends of the several wires being cross-connected and brought to a series of terminals arranged within the lamp socket in position to be traversed by a contact arm attached to a key in such a way that the current may pass directly through the socket

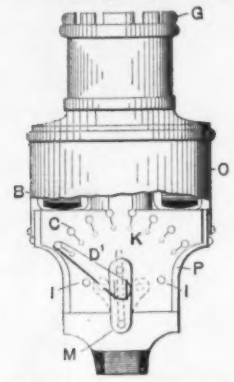
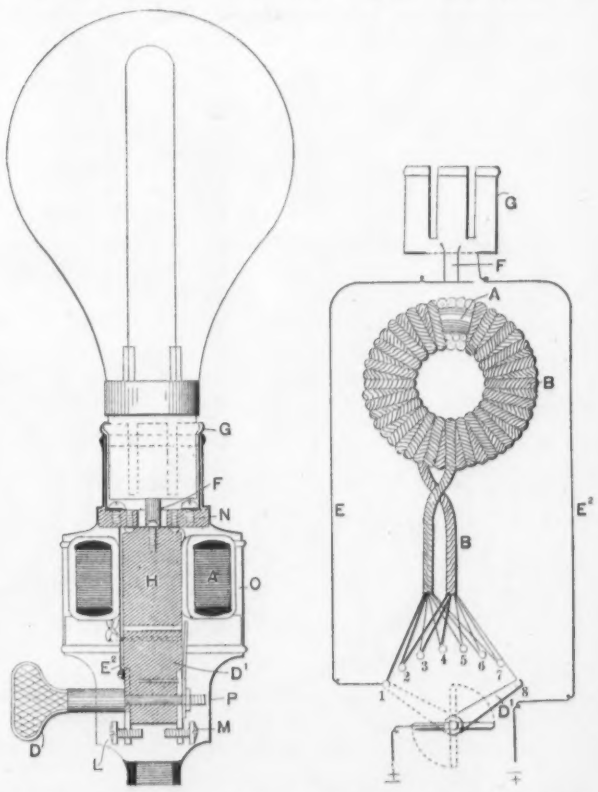


FIG. 1.—THE RIES REGULATING LAMP SOCKET.

in shunt to the wires, or may be more or less choked by being made to traverse in succession any desired number of the wires composing the strand or winding of the core.

In the accompanying illustrations Fig. 1 shows a vertical section of the entire socket with the lamp attached. Fig. 2 is a view of the socket partly in section taken at right angles to Fig. 1, and showing the regulating key and its contact terminals. Fig. 3 is a diagram showing the winding of the core and the connections. The annular iron ring *A* is wound with a strand of insulated wire, *B*, to a depth of one or two layers. The free ends of the wires of this strand or cable are brought to the contact terminals *C*, the end of one wire being connected to the beginning of the next, as shown in Fig. 3, so that all the wires of the strand are in series. The contact terminals *C* consist of screws or pins arranged in the insulating block *H* in the path of the arm *D*, which is movable between the insulating stops *I I* through an angle of 90 degrees.

The socket depends for its operation upon the well known principle of the reaction or choking coil, and in fact each socket contains within itself a complete reaction coil, as



FIGS. 2 AND 3.—THE RIES REGULATING LAMP SOCKETS.

shown in Fig. 2. By an examination of the figure the method of operation may be easily understood. When the contact arc rests upon the first of the series of terminals the flow of current through the lamp will be unobstructed, and the lamp will give its normal candle power. When the contact arm moves so as to rest upon the contact point 2, the current instead of flowing directly to the lamp will pass around the core *A* through one of the wires forming the strand *B*. This current acts in such a way upon the core as to set up a counter electromotive force in the active wire of the strand, and thus partially opposes or neutralizes the direct electromotive force between the terminals of the lamp, thus reducing the amount of current that passes through the filament, and consequently also cuts down the candle power of the lamp. As the key is moved further around, passing over the other

contact points in succession, the length of the active wire in the lamp circuit is increased, and the gradually increasing electromotive force continues to oppose more and more the flow of the current, and causes the lamp filament to decrease in brilliancy.

The method here used for winding the core with a cable instead of employing a long single wire, reduces very largely the amount of time and labor necessary for the construction of the coil. By this means it is possible also to confine the reaction coil within a very small space, so that the size of the lamp socket is not much greater than that of the ordinary key socket for incandescent lamps.

Aside from the economy claimed to be effected by the employment of this socket in the ordinary use of incandescent lamps, it is claimed that it can be applied to low voltage lamps so that they may be used upon circuits of much higher voltage than those for which they were intended.

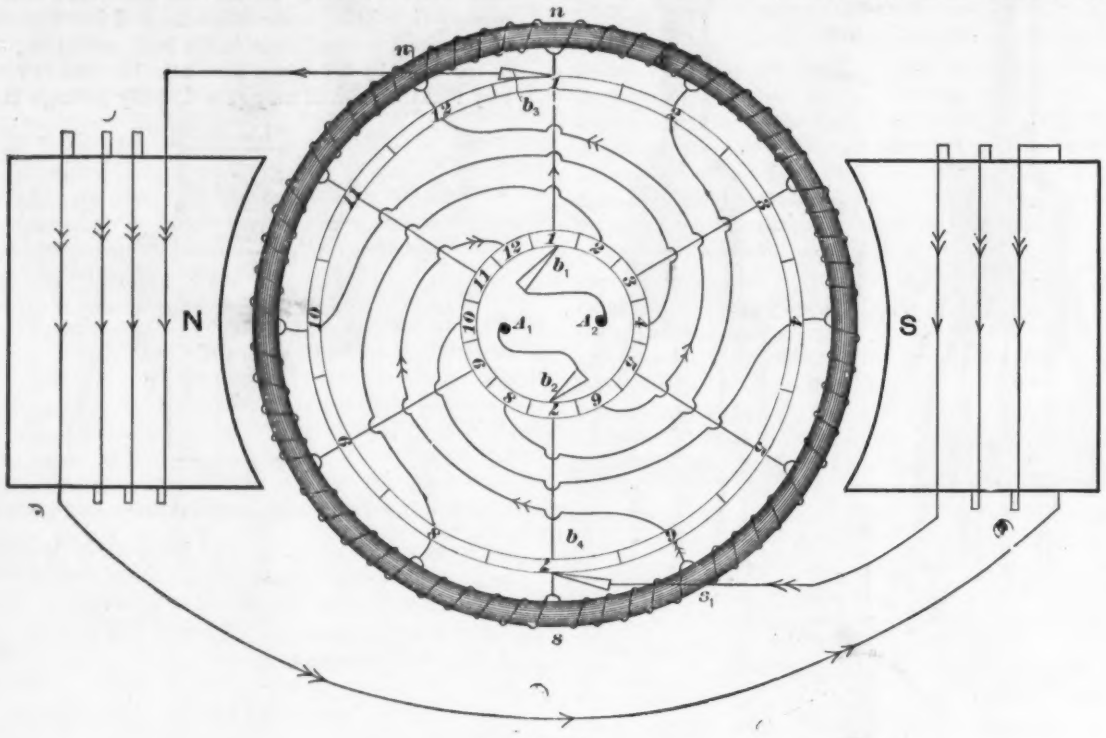


Fig. 3.

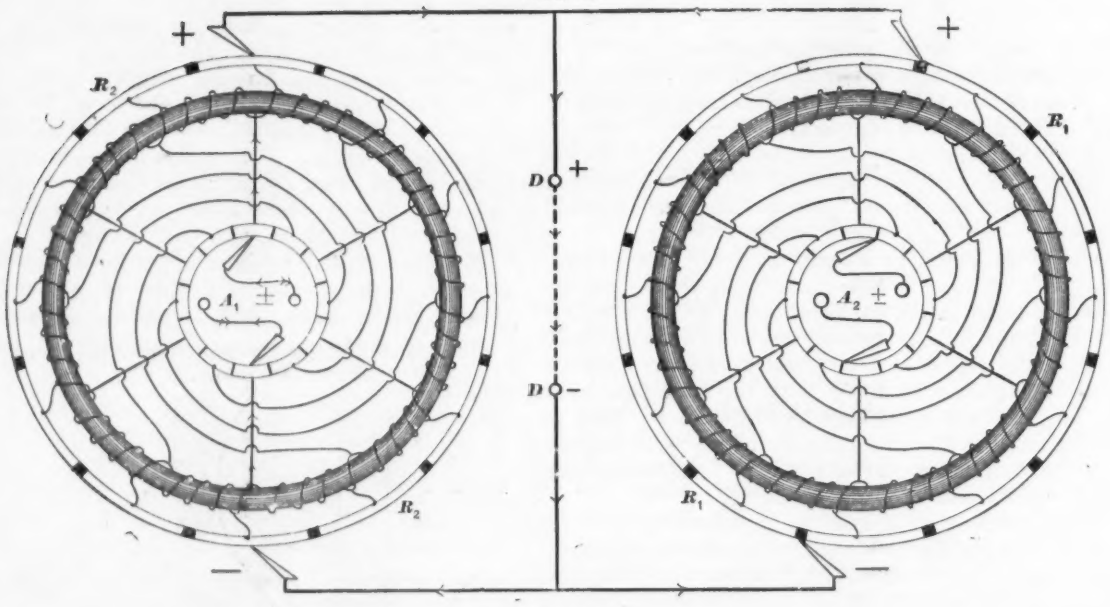


Fig. 7.

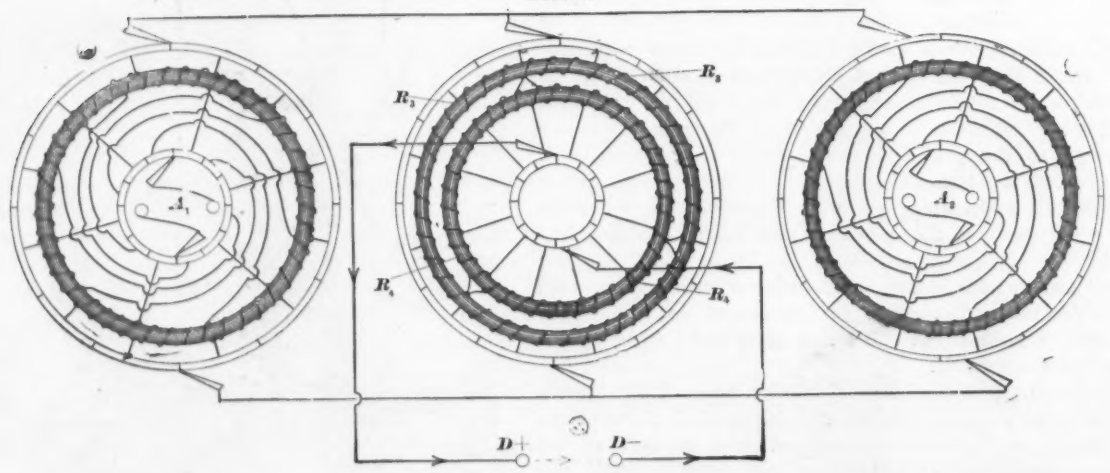


Fig. 10.

A Proposed System of Alternating-Direct Current Transformation.—II.*

BY LIEUT. F. JARVIS PATTEN.

Returning, now, to Fig. 3, the current in a circuit connected to the brushes bearing on the outer collector will be a single alternating current, rectified like that shown in Fig. 4, and will have zero values corresponding to each reversal.

But if two alternating currents, having a quarter phase difference, be rectified and superposed, a comparatively uniform direct current like that shown in Fig. 5 will result. To obtain this, two armatures like that shown in Fig. 3, secured to a common spindle, are placed in the same field and are supplied with independent alternating currents differing in phase by a quarter period. This arrangement is shown by diagram in Fig. 7, where the fields are omitted, alternating currents differing by a quarter period being supplied at A_1 and A_2, a comparatively uniform direct current like that pictured in Fig. 5 will flow in the circuit $D+$ $D-$. If, now, these terminals be connected to the brushes of an armature like that shown in Fig. 6, we will have the combination already referred to, in which the middle armature has an ordinary collector shown outside the winding, and three rings with brushes connected to three equidistant points of the winding. The fields are omitted as before and all three windings will be supposed fixed to the same spindle and external circuits; a_1, b_1, c_1, are connected to the brushes bearing on the r_1, r_2, r_3 of the middle armature.

A singular transformation is made possible by this device. Thus single alternating currents differing a quarter phase, supplied at A_1 and A_2, are transformed in the ring R_3 to triphased alternating currents, but a peculiar feature is here introduced which results from the fact that the triphased currents are only reversed at each half revolution of the ring R_3, the same as in Fig. 6, while the alternating currents supplied at A_1 and A_2, as we have seen, are reversed as many times in a single revolution of the rings R_1 and R_2 as there are collector segments, or say 12 times per revolution.

As the currents differing a quarter period, supplied at A_1 and A_2, can be obtained on known methods from a single alternating current, we have then here presented the means of transforming a single alternating current of short wave length or high frequency into triphased alternating currents of long wave length or low frequency.

Thus a single alternating current making 12 reversals in the time t_0 to t_2, is transformed to triphased alternating currents, making but two reversals in the same time, these latter curves representing as they do the currents in the circuits during one revolution of the armature.

The next step consists in changing these triphased currents to a uniform direct current on the plan used in the Shuckert machine, Fig. 6.

Thus, referring to Fig. 10, the winding of the ring R_3 instead of having three equidistant points connected to rings as before, has them connected to corresponding points of another winding. R_4, placed on the same core and provided with a separate collector; but to avoid confusion of the drawing the two windings are here shown separately, one inside the other.

Here, as in Fig. 6, a circuit connected to the brushes bearing on the collector of the ring R_4 will be supplied with a direct current of uniform E. M. F., resulting from the conversion to a direct current of the triphased currents delivered from the winding R_3 to the winding R_4.

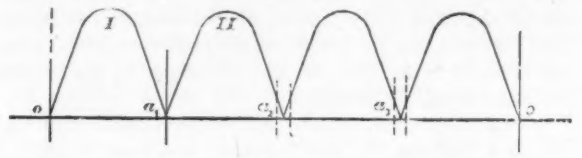


Fig. 4.

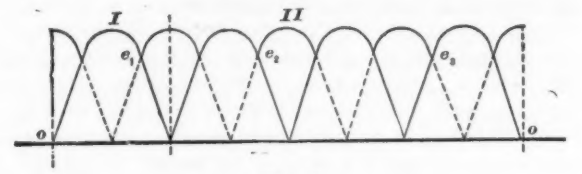


Fig. 5.

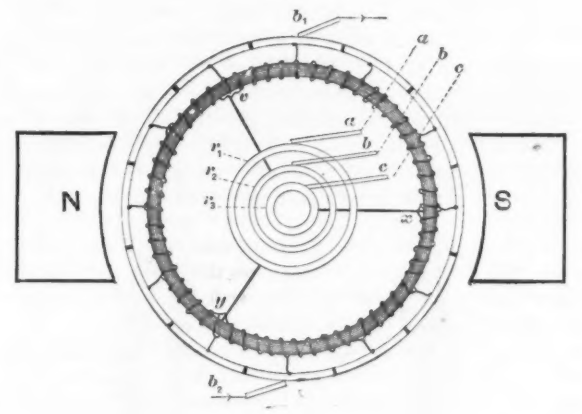
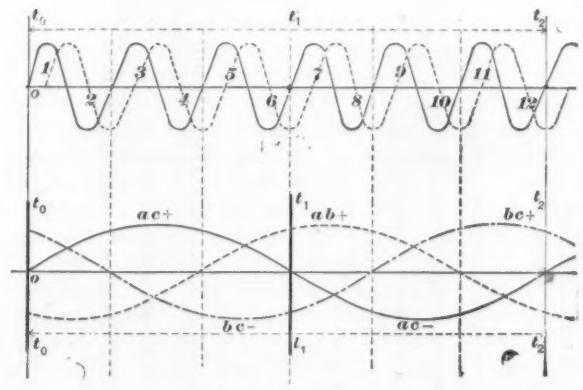


Fig. 6.



Figs. 8 and 9.

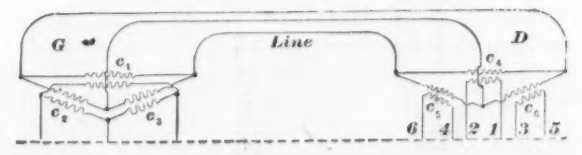


Fig. 11.

Here, then, is the means of transforming a single alternating current to a continuous direct current of uniform E. M. F.

Machines like the last two described seem complicated, but approximate, if not quite as good results, can be obtained from simpler devices. The preceding details were necessary to explain the consecutive steps taken.

If a three-wire system, like that shown in Fig. 11, is used throughout, giving triphased currents at the delivery end D, from the secondaries of the three converters, the transformation of these triphased currents to a single direct current of uniform E. M. F., or to triphased currents of a much

DIAGRAMS OF PATTEN'S PROPOSED SYSTEM OF ALTERNATING DIRECT-CURRENT TRANSFORMATION.

* Abstract of a paper read before the American Institute of Electrical Engineers.

lower frequency of alternation, can be accomplished on similar lines. It is well known that multiphase motors give better results with currents of comparatively low frequency, 40 to 80 per second being the reported practice abroad.

On the other hand, the converters for reducing potential increase rapidly in size as the frequency of alternation decreases, consequently very large converters are required for such systems. These features are antagonistic and render the conversion apparatus costly if low frequencies are essential to the proper working of rotary field machines.

At the delivery end D, Fig. 11, separate converters, c_4, c , c_6 (not interlinked) are used, the secondaries having free terminals, as shown, which are taken to the brushes 1, 3, 5 and 2, 4, 6, bearing on the commutator of the ring R_2, the winding of which is connected at three equidistant points, x, v, y, of the ordinary Gramme ring and collector R_3, or to three ring contacts, as may be desired, according to whether a direct current or triphased current is required, as a result of the transformation. The machine R_1 is simply a synchronizer, requiring only sufficient power to drive the apparatus, and is supplied with one of the triphased currents only.

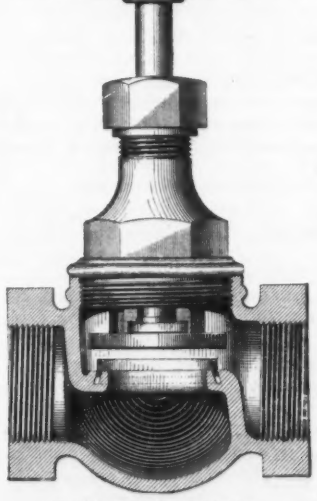
The Roy Valve.

The conditions to which stop valves are subject and that tend to impair their efficiency are not always provided for. New valves, though well tested when made, often fail to be tight when put in service, and a leaky valve soon works its own destruction. The joint's position in the body does not admit of noting the condition of the valve when in service. Its condition when operated indicates only the success or failure in making a joint. Should it fail and leak, the application of a lever or wrench to the valve handle is usually resorted to, and a collapsed seat, bent stem, bulked disc or strained body are the common results of such practice. New and old pipe systems contain sand, scale, grit, borings, and other substances that are trapped in the valve body and lodge on the surface of the seat. This is one of the prime causes of valve injury. The end and side thrust or sagging of expanding pipe lines, or the force used in fitting the screwed or flanged ends of the valve body, will often distort the face of the seat and cause it to be out of true. What is wanted is a seat that will not be injured by the ordinary force of a wrench applied to the valve handle, and which will afterward be efficient when operated in the usual manner.

The above defects, it is stated, are overcome in the Roy valve, an illustration of which appears herewith, which, it is claimed, possesses numerous original features. It contains a method of making a joint that is a radical departure from the usual manner of joint making, in a valve body, and assures a tight joint under all conditions. It makes a simple metallic joint which combines the essential features of a ball and socket, and of the well known expanded joint, such as is used on boiler tubes, in heads.

It is simply a jointless ring of expansive material inserted in the body and is as simple in application as a washer. Any kind of malleable material is used, such as copper for steam, iron for ammonia and lead alloys of different kinds for water. The ring rests on a conical base and its action, to compensate for distortion of the joint, is as follows: A ring resting on a conical base will make contact on its entire inner edge, if both ring and base are true. If the base be distorted, the ring will touch on two or more spots, depending on the degree and nature of the distortion. When a pressure is put on the upper edge of the ring by means of a flat disc, the ring is forced outward by the prominent points on the conical base, and drawn inward to fill the depressions. The plane of the top surface of the ring remains undisturbed, but free to move laterally on the face of the disc and an extraordinary degree of distortion is thereby provided for.

These valves are manufactured by the Roy Valve Company, 15 Cortlandt street, New York.



THE ROY VALVE.

The Compression of Fibre Goods.

The accompanying illustration shows a reinforced cylinder press, with automatic reverse action cylinders, which is intended for the compression of fibre goods, very large quantities of which are now used in the electrical industries. It is manufactured by Messrs. Watson & Stillman, No. 204 East 43d street, New York City.

The illustration here given represents one of a number which are now used in electrical work. The beam acting strain on the cylinder is taken up by reinforcement of the body of the cylinder and not by a separate yoke. On account of the motion being too great to allow the ram to be taken out for repacking the cylinder without taking down the press, the packing is placed underneath a gland. Small downward acting automatic cylinders of 12 tons capacity

THE FIBRE GOODS COMPRESSOR.

are placed on each side of the press, and force the ram back very quickly and steadily, at the same time clearing the dies which may happen to be in the press if they should stick together. These presses are made with 10 and 12-inch rams, the complete machines weighing respectively 3,150 and 6,300 pounds.

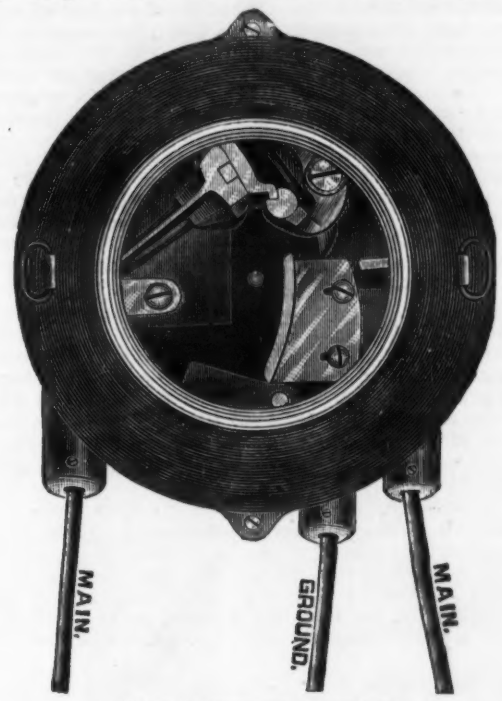
Double Contact Arc Switch.

The illustration shows a double contact arc switch, new and original in design, which is manufactured by the Utica Electrical Manufacturing and Supply Company, of Utica, N. Y. It is substantially made, has heavy brass binding posts, phosphor-bronze contacts, and is mounted on slate, inclosed in a water-tight iron case. It is automatic in its design when started in either direction, and is made to carry 50 or more ampères. It can be operated without causing an arc, and the "make or break" of contacts is not dependent, it is stated, on the slow or fast movement of the operator's hand. The case is provided with porcelain bushings for the protection of wires in entering and leaving the box.

DOUBLE CONTACT ARC SWITCH.

A New Lightning Arrester.

The danger from lightning discharges to which dynamos railway generators and motors and other electrical appliances are subject, is a matter of great importance to central stations, power stations, electric railways and users of electric power generally. Many appliances designed for protection from lightning discharges have been brought out from time to time, some of them possessing many points of merit. We show in the illustration a lightning arrester which is manufactured by the Utica Electrical Manufacturing and Supply Company, of Utica, N. Y. It is especially designed for the protection of high or low tension, direct or alternating dynamo machines. It is said to be simple and absolute in its action, and does not introduce extra resistance in the line. There being no magnets to burn out, the contacts are large enough to carry heavy currents or discharges of lightning. It



A NEW LIGHTNING ARRESTER.

stated that this apparatus has been examined by experts and pronounced perfect in its working.

A Twist Drill and Surface Grinder.

We give an illustration of the Challenge twist drill and surface grinder, which consists of an upper and lower slide bracketed to a column and adjusted by convenient hand-screws. On the upper slide there is a holder for the drill and the base of this slide is trunnioned to the lower one, so that by swinging the holder the drill is made to pass across the face of a cupped wheel, and when the holder is set at zero imparts a slight oval to the point, which is varied at will—there being graduations for any size drill—and on the upper slide a graduation is likewise provided for a similar purpose—passing the central point of the trunnion—which extends the capacity of the machine, its range being from the smallest size up to two inches. In this lies its special advantage.

The surface grinder is designed for grinding dies, punches, gibs, parallel and irregular shaped pieces—a great variety of general work. It is also very useful, it is stated, for special work. The table is 9 × 18 inches, planed and leveled true, and counterbalanced to drop 10 inches from the wheel, and is adjusted to or from it by a large hand wheel, rack and pinion, and has a binding screw to hold it at any point along the ways, which are planed and gibbed. The table also has a supplemental adjustment to bring the work to the wheel from a mere touch to as deep a cut as may be desirable, all being accurately fitted and true. These drills are manufactured by the Appleton Manufacturing Company, of Philadelphia, Pa.

TWIST DRILL AND SURFACE GRINDER.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, March 12, 1892.

The conditions of the market during the week have been diversified with days of strength and weakness. It has been an active market, but most of the business has been confined to a narrow range of specialties. The affairs of the railroad companies have absorbed the majority of the interest, and the industrial and electric stocks have played a minor part. On the whole, however, there has been an undertone of strength, although the week closes with lower prices in many of the stocks. The gold shipments, the pending silver legislation and general dullness of trade prevent any unusual activity in the market, but none of these influences are sufficiently strong to counteract the firmness which is evident on all sides. There has been little or no change in the money market, so far as actual rates are concerned. A careful survey of the whole situation, as it is influenced by gold and silver matters, still gives the impression that easy money will continue for some time. Call loans are quoted at three to four per cent., and good time loans from four to five per cent. Money between the banks loans at two per cent.

Bell Telephone stock showed a sudden decline of eight points to 201, due to a recent vote of the directors to ask the stockholders to authorize the issue of new stock at the annual meeting, which will be held March 29. The new stock will be offered to the stockholders at par, in the ratio of one share for six old shares. The rights will be worth about $16 on the present market price. This decline is not unusual, for when former additions have been made to the stock it has experienced the same fluctuations by stockholders selling a few shares in order to buy extra rights.

Edison General Electric stock has sold in small lots throughout the week at 97 and 98. Thomson-Houston has sold in small lots at 58⅛ to 59¼. Fort Wayne has remained at the low price of about 12⅛. This is due evidently to the report of a decrease in the dividend, but even then it would pay at these figures 8 per cent., and have a guarantee behind it which should secure it perfectly.

Westinghouse Stock.—There has been some buying in Westinghouse by New York parties. The stock has had two or three sudden advances, and there is evidence of considerable strength behind it, so that higher figures are confidently looked for in the near future. Whatever may be the course pursued by this company toward the consolidated company, the stock has intrinsic value at higher figures, and is independent of outside influences. The good buying of the past week shows a strong backing behind it.

Increase of Capital Stock.—The Peoples' Electric Light and Power Company, of Oswego, N. Y., has certified to an increase in capital stock from $100,000, consisting of 1,000 shares, to $110,000 consisting of 1,100 shares; the Grants Pass (Oregon) Water, Light and Power Company has certified to an increase in capital stock to $170,000; the East Aurora (N. Y.) Electric Light Company has certified to an increase in capital stock from $12,000 to $20,000.

New Stock to be Issued.—The Bell Telephone directors have voted to issue $2,500,000 new stock, one share at par to each holder of six shares. This will give the company a total capital of $17,500,000, with the right to put out $2,500,000 more, to make the $20,000,000 authorized by the Massachusetts Legislature.

Stock to be Listed.—The stock of the Toronto Incandescent Light Company, of Toronto, Canada, will be listed on the Toronto Exchange in a short time.

The West End Street Railway Company, of Boston, it is stated, will show for the month of February an increase of net earnings of about $40,000 over the corresponding period last year.

Reports of Earnings.—The following shows the condition of the Western Union Telegraph Company at the close of the quarter ended Dec. 31, 1891: Surplus Oct. 1, 1891, as per last quarterly report, $12,269,190.31; net revenues, quarter ended Dec. 31, 1891, $1,907,166.66; total, $14,176,356.97. Deducting from which for dividend of 1¼ per cent. paid Jan. 15, $1,077,408.81; interest on bonded debt, $222,331.05; sinking funds, $20,000—$1,319,739.86, left a surplus Jan. 1, 1892, of $12,856,617.11. The net revenues of the quarter ending March 31, based upon returns nearly completed for January, partial returns for February, and estimated business for March, will be about $1,550,000; add surplus Jan. 1, as above, $12,856,617.11, making $14,406,617.11. From which appropriating for interest on bonds, $222,330; sinking funds, $20,000—$242,330, leaves a balance of $14,164,287.11. It requires for a dividend of 1¼ per cent. on the capital stock, $1,077,408.11, deducting which leaves a surplus, after paying dividend, of $13,086,879; the Edison Electric Illuminating Company, of Brooklyn, whose bonds are now being offered, referred to elsewhere in this issue, commenced operations Sept. 1, 1889. The total lamp equivalent connected March 1, 1892, is 44,709. During January and February of this year there have been added more than 3,300 additional lamps, and orders for 10,000 more are in hand to be connected by May 1. The percentage of gain in results, 1891, compared with 1890, shows increase in gross earnings, 90 per cent.; increase in expenses, 33 per cent.; increase in net earnings, 140 per cent. January, 1892, net earnings were $9,114.91, compared with $6,127.73 in 1891. February, 1892, net earnings were $9,028.92, compared with $4,949.60 in 1891. The company is paying regular quarterly dividends of 1 per cent. on its capital stock, having begun same for the quarter ending June 30, 1890.

Dividends.—The Western Union Executive Committee met Tuesday, March 8, and recommended the declaration of a quarterly dividend of 1¼ per cent. by the directors at their meeting on March 9, at which time the directors met and declared the dividend as above, payable from the net earnings of the three months ending March 31, on and after April 25, to stockholders of record at the close of the transfer books on March 18. There was evident disappointment on the failure to increase the dividend to 1½ per cent. Members of the Executive Committee state that this quarter, being the poorest of the year, was not considered the best period in which to increase the rate, but they say that the dividends will certainly be increased to the rate of 6 per cent. per annum before the end of this year. The hundred and tenth dividend on the stock of the Montreal Telegraph Company has been paid to the shareholders. This is the forty-second quarterly payment of the 8 per cent. dividend guaranteed by the Western Union Telegraph Company. The Bell Telephone Company has declared a dividend of $3 per share, payable April 15, to stockholders of record March 31. The Commercial Cable Company (Mackay-Bennett cables) has declared a quarterly dividend of 1¾ per cent., payable April 1. The Southern New England Telephone Company has executed a mortgage to the Union Trust Company of New Haven, to secure an issue of bonds to the amount of $500,000, to be used in extending the lines. They are 5 per cent. semi-annual 5-20 year bonds; 400 of them are for $1,000, and 200 of $500 each. There is a previous mortgage of the company of $300,000, which is to be protected by a deposit of $300,000 of the new bonds. The Citizens' Electric Illuminating Company, of Brooklyn, N. Y., has declared a quarterly dividend of 2 per cent., payable April 1.

Bonds.—The Union Electric Company, of Seattle, Wash., capitalized at $1,000,000, concerning the formation of which our Tacoma correspondent has something of interest in this issue, has been bonded for $500,000 by the New York Guarantee and Indemnity Company, and the proceeds will be used to liquidate outstanding obligations of the two old companies. $500,000 first mortgage five per cent. gold bonds of the Edison Electric Illuminating Company, of Brooklyn, N. Y., are being offered by Spencer Trask & Co. and the Franklin Trust Company of Brooklyn. These bonds are dated Oct. 1, 1890, due Oct. 1, 1940, and are redeemable at 110 and interest after Oct. 1, 1900, at the company's option. The company controls by license from the parent company the exclusive right to produce and distribute electric light and power for Brooklyn. The total issue of bonds under the mortgage is limited to $2,500,000; and they never can be issued in excess of 50 per cent. of the outstanding capital stock. $5,000 in six per cent. bonds will be issued by Calvert, Texas, for the purpose of electric lighting. The Ottumwa (Ia.) Electric Railway Company will issue $100,000 first mortgage bonds, interest six per cent. proceeds to be expended in extending and improving the plant.

The Edison-Thomson-Houston Consolidation Operative.—The committee of stockholders of the Edison General Electric Company and the Thomson-Houston Electric Company has announced that a majority of the stockholders of the two companies have assented to the agreement dated Feb. 9, and that the agreement has now become operative. The time for depositing Thomson-Houston and Edison stock has been extended to March 21. The committee has announced that stockholders who fail to deposit their stock on or before March 21, shall forfeit any right to come in under the agreement of Feb. 9, except by the express permission of the committee and on such terms as it may impose.

Annual Reports.—The annual report of the Standard Electric Company, of Detroit, Mich., shows capital stock, $1,000,000; paid in, $695,410; real estate, $15,231.09; personal estate, $6,090.73; debts, $7,326.18; credits, $890.70.

Closing Quotations.—The following were the closing quotations of electric stocks on Saturday, March 12, 1892, in New York and Boston:

NEW YORK QUOTATIONS.

Name of Stock.	Par.	Capitalization.	Bid.	Ask'd.
Western Union Telegraph Co	100	86,200,000	88	88¼
Commercial Cable Co	100	7,716,000	150	155
Edison General Electric	100	15,000,000	96½	97
Consolidated Electric Light	100	2,500,000	20	30
Edison Illuminating Co., of New York	100	4,500,000	81½	82½
" " " Brooklyn	100	750,000	74	78½
" " " Chicago	100	750,000	138	142
U. S. Illuminating Co	100	1,250,000	30	35
Edison Elec. Light Co. (of Europe) stock	100	2,000,000	2½	5
" " " " bonds	sh	30,000	65	75½
" Ore Milling Co	100	2,000,000	17½	22½
" Toy Phonograph Mfg. Co	10	1,000,000	....	½
U. S. Electric Light Co	100	1,500,000	10	20
Brush Illuminating Co., of New York	50	1,000,000	40	50
Mt. Morris Electric Light Co		500,000	20	40
East River Electric Light Co	100	1,000,000	....	60
North American Phonograph Co	...	6,600,000	4½	6
New York Phonograph Co	...	2,000,000	3	4
Automatic Exhibition Co	...	2,000,000	2	2½
New England Phonograph Co	...	2,000,000	1¾	2¾

BOSTON QUOTATIONS.

	Par.	Capitalization.	Highest.	Lowest.	Bid.	Ask'd.
Thomson-Houston Elec	25	6,000,000	59½	58½	58½	58¾
Thomson Houston Elec. preferred	25	4,000,000	29	28¾	28⅝	29
Thomson-Houston Elec.—Series C	sh	40,000	....	....	8⅛	9
Thomson-Houston Elec.—Series D	sh	120,000	7½	7¼	7¼	7¾
Thomson-Houston Int'n'al Elec	100	600,000	....	....	200	210
Thomson-Houston Int'n'al Elec—Pfd	100	400,000	....	....	102	104
Thomson Elec. Weld	100	1,000,000	....	....	55	60
Thomson European Elec. Weld	100	1,500,000	12⅛	....	12	12½
Westinghouse Elec.—Pfd.	50	10,000,000	27⅝	25¼	27	27⅛
Westinghouse Elec.—Trust receipts			16¾	15	16⅜	16⅝
Fort Wayne Elec	25	4,000,000	13	12⅜	12½	12¾
Fort Wayne Elec.—Ser. A.	sh	80,000	7¼	....	7¼	7⅜
Detroit Elec	10	1,000,000	8	....	....	8
West E. & St. Ry. Co.—Com	50	7,150,000	74	73⅜	74¼	74½
West End St. Ry. Co.—Pfd	50	6,400,000	87¼	86¾	87⅛	87½
American Bell Tel	100	15,000,000	209	201	202	202½
Erie Tel. & Tel. Co		4,800,000	46½	46¼	45½	46½
Mexican Tel. Co	10	1,280,000	....	....	$1	1⅛
New Eng. Tel. & Tel. Co.		10,304,600	52	....	51	....
Tropical Tel. Co	10	400,000	....	....	....	50

NEW INCORPORATIONS.

The Columbian Launch Company, of Chicago, Ill., capital stock $200,000, has been formed to purchase and operate launches run by steam, electricity, hot air or oil. Thomas B. Marston, Henry N. Tuttle, and W. S. Spotton are the incorporators.

The Idaho Electric Light and Power Company, of Wallace, Idaho, with a capital stock of $500,000, has been formed to build and operate a plant for the purpose of generating light and power. C. W. O'Neil, F. C. Loring, and F. E. Lucas are the promoters.

The Fond Du Lac Electric Company, of Fond du Lac, Wis., capital stock $10,000, has been organized to operate an electric street railway. F. B. Hoskins, E. A. Cart, William McDermatt, E. Coleman and D. D. Sutherland are the incorporators.

The Creede Building and Improvement Company, of Amethyst, Colo., capital stock $1,000, has been formed to establish and maintain street railways, water-works, electric lights, etc. Geo. J. Shackelford, Geo. J. Petterson and Alex. C. Foster are the promoters.

The Peninsular General Electric Company, of Grand Rapids, Mich., capital stock $30,000, has been formed to manufacture and sell electrical appliances and apparatus. T. C. Harmish, F. M. Champlin and Andrus Beveir, all of Grand Rapids, are the incorporators.

The Champaign Rapid Transit Company, of Chicago, Ill., capital stock $50,000, has been formed to build and operate a line of street cars in Champaign city and county, and to furnish electric light and power. The promoters are John Ahern, S. A. Power and Clint C. Rush.

The Lawrence Manufacturing Company, of Columbus, O., with a capital stock of $30,000, has been started to manufacture and sell electrical and other machinery, fixtures, etc. The incorporators are Wm. B. Lawrence, E. O. Jones, J. P. Bliss, Edgar M. Wasson, and Clarence M. Jones.

The Consolidated Electric Company, of Burlington, Vt. with a capital stock of $150,000, has been formed to manufacture, generate and sell electricity for light, heat and other purposes. The incorporators are A. E. Richardson, U. A. Woodbury, Willard Crane, and Edward A. Pope, of Burlington, Vt.

The Rich Electric Heating Company, of Elizabeth, N. J., with a capital stock of $250,000, has been formed to manufacture, sell and rent electric plants, etc. S. M. Weed, Plattsburgh, N. Y.; H. N. Bailey, S. H. Gray and J. W. Rich, Mt. Vernon, N. Y., and G. H. Plumb, of Elizabeth, are the incorporators.

The Shawneetown Electric Company, of Shawneetown, Ill., capital stock $20,000, has been started to construct, maintain, use and operate an electric light and power plant, with all necessary appurtenances, to furnish electric light and power. G. C. Travis, W. M. Rickett and Annie J. Travis are the incorporators.

The Pennock Electric Company, of Los Angeles, Cal., capital stock $1,000,000, has been formed for the manufacture of electricity, light and power, and deal in real estate, etc., in Los Angeles, Cal. The promoters are John P. Culvert, W. W. Robinson, Adolph Erdman, A. C. Taylor and R. R. Haines, all of Los Angeles, Cal.

The Winona Light, Heat and Power Company, of Winona, Minn., capital stock $150,000, has been incorporated to construct and operate a plant for furnishing electricity, etc. W. E. Bromhall, B. F. Meek, Jr.; W. P. Johnson, S. P. Welles, Jr.; C. K. Stearns, and H. M. Byllesby, all of St. Paul, Minn., are the organizers.

The Citizens' Power and Light Company, of Ashtabula, O., capital stock $5,000, has been formed to supply electricity for light and power purposes. A. J. Beckwith, Ed. S. Henry, R. M. Johnson, J. B. Topky, C. F. Schaffner, Jno. P. Devney, M. M. Kinkle, W. S. McKinnon, E. W. Savage and A. F. Dickinson are the incorporators.

The W. W. McMillan Company, of Duluth, Minn., capital stock $50,000, has been organized to keep and handle electrical goods and generate electricity for light, heat and power, etc., etc. W. W. McMillan, W. Horwood, R. Cox, J. T. Boyd, J. J. Burns, J. P. Fairgrieves and D. L. Johnson, all of Duluth, are those directly interested.

The Fort Dodge Gas, Electric Light, Heat and Power Company, of Fort Dodge, Ia., capital stock $50,000, has been formed to erect and operate a light, heat and power plant in the city of Fort Dodge, Ia. Jno. L. Marvin, Jas. S. Cummins, Geo. M. Shearer, J. W. Campbell and L. Brandon, all of Fort Dodge, are the incorporators.

The Connecticut Pipe Manufacturing Company, of Orange, Conn., P. O. West Haven, capital stock $150,000, has been formed to purchase, construct and operate water works, electric light plants, etc. The organizers are Ed. H. Phillips, of New Haven, Conn.; Wm. H. Childs, of Manchester, Conn., and Geo. O. Richards, of West Haven.

The Electric Bleaching Company, of Jersey City, N. J., with a capital stock of $2,000,000, has been organized to manufacture machinery for bleaching and cleaning fabrics, etc. T. J. Montgomery, of Larchmont, N. Y; C. M. Bowley, of Poughkeepsie, N.Y., and R. W. Elliot, of 109 Montgomery street, Jersey City, N. J., are the incorporators.

The United States Volta Electric Battery Company, of Charleston, W. Va., with a capital stock of $1,015,000, has been formed to buy, make and sell galvanic batteries, and other electrical inventions. Geo. F. Jackson, Minneapolis, Minn.; Ellery C. Tankersley, Brooklyn, N. Y., and D. S. Dolbear, of New York City, are those interested.

The Pennock Battery Electric Light and Power Company, of Portland, Me., has been incorporated, capital stock $1,000,000, to manufacture and deal in all kinds of incandescent and other electric lights, electric bells and machines of all kinds. The incorporators are George W. Moses, William H. Hunt and S. P. Tenney, of Chelsea, Mass.

The Leonard Avenue Street Railway Company, of Columbus, O., has filed articles of incorporation, capital stock $10,000, to construct and operate a street railway in Columbus, O., to be operated by electric or other motive power. The promoters are Theodore Leonard, George E. Roberts, William Shepard, Moses H. Neil and James H. Anderson.

The Pneumatic Torpedo and Construction Company, of New York, capital stock $250,000, has been formed for the purpose of carrying on any kind of construction, electrical, mechanical, building torpedoes, for war or commercial business, guns, projectiles, etc. W. M. Cramp, of Philadelphia; H. L. Taylor and C. L. Davis, both of Brooklyn, are the promoters.

The Pennsylvania Electric Engineering Company, of Camden, N. J., with a capital stock of $25,000, has been organized to act as agents for the sale and manufacture of electric light and power supplies, etc. A. L. Bosley, L. R. Schultz and G. H. Schultz, of Philadelphia; R. W. Tingley, Germantown, Pa., and C. V. D. Joline, of Camden, N. J., are the promoters.

The Northern Light Electric Company, of St. Paul, Minn., capital stock $40,000, has been formed to construct, operate and maintain a plant for generating electricity for light, heat and power; manufacture and repair electrical appliances, etc., etc. The promotors are H. M. Byllesby, H. C. Levis, Wm. Ely Bramhall, B. F. Meek, Jr.; W. P. Johnson, S. P. Wells, Jr.; C. K. Stearns, all of St. Paul.

The Helena Water Power Company, of Helena, Mont., with a capital stock of $2,000,000, has been started to construct a dam across the Missouri River at a point east or northeast of Helena, and to obtain water power, thereby to generate electric currents for mannufacturing and other purposes. R. S. Vivian, Kansas City, Mo.; J. H. Lawrence and Ashburn K. Barbour, of Helena, Mont., are the incorporators.

AFFAIRS OF THE COMPANIES.

Stockholders' Meeting.—A meeting of the Adams Electric Company, of St. Louis, will be held Monday, March 21, for the purpose of electing seven directors and the transaction of other business.

The Carondelet Electric Light and Power Company, of St. Louis, Mo., at its recent meeting elected officers as follows: John Krauss, president; O. A. Haynes, vice-president; F. W. Mott, secretary, and R. J. Kilpatrick, treasurer.

The Citizens' Electric Light Company, of Helena, Mont., has been absorbed by the Helena Electric Company, it is stated, thus making but one electric lighting company in the city. It is said a reduction is to be made in the price of lights at an early day.

The Pennsylvania Electric Engineering Company, of Philadelphia, Pa., recently incorporated for $25,000, has elected the following officers: Arthur L. Bosley, president and manager; Benj. W. Tingley, vice-president; Louis R. Schultz, secretary and treasurer, and Fredk. S. Koons, assistant secretary.

The St. Louis Electric Power Company, of St. Louis, Mo., will hold a meeting of the stockholders May 2d, for the purpose of voting upon an increase in the capital stock of the company from $30,000 to $75,000, and to change its name from St. Louis Electric Power Company to St. Louis Electric Light and Power Company.

The Pennock Battery Electric Light and Railway Company, organized recently at Rockland, Me., for the purpose of manufacturing electric apparatus and applying electricity in all its forms, has elected the following officers: President, G. W. Moses, of Chelsea, Mass.; treasurer, S. P. Tenney, of Chelsea, Mass.

Milwaukee, Wis.—Mr. E. C. Wall is now president and general manager of the Edison Electric Light Company as well as of the Badger Illuminating Company. He succeeds Henry C. Payne as president of the Edison company. Though Mr. Wall is at the head of both companies, the business is distinct and will remain so.

The Fort Dodge Gas, Electric Light and Power Company, of Fort Dodge, Ia., has elected officers and directors as follows: The officers are: L. Blanden, president; H. S. Manning, vice-president; J. W. Campbell, secretary and treasurer. L. Blanden, H. S. Manning, J. L. Martin, J. W. Campbell and G. W. Shearer were elected directors. The consolidation will be completed the first of April.

The Topeka Rapid Transit Company, of Topeka, Kan., has been reorganized and placed upon a good financial basis, the pending foreclosure suit having been dismissed on an order from the Metropolitan Trust Company. The floating debt has been paid, and of the $342,000 of bonded debt formerly outstanding $92,000 has been retired, leaving the total debt of the road only $250,000, bearing interest at 6 per cent.

An Electric Company's Assets.—The account of Samuel W. Wray, receiver of the Electric Power Company, of Philadelphia, Pa., has been filed in Common Pleas Court, No. 4. Mr. Wray states that from April 1, 1891, to Feb. 13, 1892, he has received from various sources $25,635.08, and has made disbursements for expenses and other necessary expenditures aggregating $22,513.51, leaving a balance in his hands for distribution of $3,121.57. Judgment was entered by the Fort Wayne Electric Company against the Electric Power Company for $7,586.07 for want of an affidavit of defense in a suit brought on three promissory notes for $2,399.25, and two for $2,411.02.

Street Car Lines Leased.—A lease from the Newark (N. J.) Passenger Railway Company, which controls most of the street car lines in Newark, to the New Jersey Traction Company, has been recorded in the county clerk's office. It is for 999 years, and covers all the lines, equipments, and franchises both of the Newark company and of the Rapid Transit Company, which the Newark Passenger Railway Company recently absorbed. The Traction company is to operate the roads and to pay to its lessee $45,000 for rent in 1892, $60,000 in 1893, and an increase of rent at the rate of $30,000 each successive year, till in 1899 the rent reaches its maximum of $240,000 a year. It is to remain $240,000 a year from 1900 to the year 2891. The payment of the rents is to be semi-annual, and to the Manhattan Trust Company, of New York, as the agent of the Newark Passenger Railway Company.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-177 TIMES BUILDING, NEW YORK, March 14, 1892.

J. D. McIntyre, of the Electrical Engineering and Supply Company, of Syracuse, was in the city during the past week.

Mr. Arnold von Siemens, of the Siemens & Halske Electric Company, of Berlin, was in the city last week. He sailed on the Fulda Saturday last for Genoa, Italy.

The Atlantic Avenue Railroad, Brooklyn, N. Y., has decided on the location of its new power house, and the contract for the motors will probably be given out in a few days.

J. H. Rhotehamel, general manager of the Columbia Incandescent Lamp Company, of St. Louis, made us a pleasant call this week. His company has secured one order of 10,000 lamps within a few days.

The Evansville (Ind.) Street Railway Company.—Twenty-two miles will be equipped at once electrically. Messrs. Barry & McTighe, 52-54 William street, New York, are the engineers in charge.

F. G. Ryder and M. M. Jacobs, formerly of the Star Electric Company, Binghamton, N. Y., have opened offices in the *Evening Post* building, this city, under the name of the New York Electrical Engineering Company.

The plans of the new power house of the Brooklyn City Railroad have been practically decided on, and the station will be located on Fifty-second street, South Brooklyn. The immediate capacity will be 8,000 h. p. with a total capacity of 13,000 h. p.

The Electric Construction and Supply Company, of this city, who are always equal to every occasion, have, in response to a popular demand, begun the manufacture of ornamental arc lamps. The designs will be of the finest and the finish will be brass, dull and polished.

The Board of Electrical Control's report to the Mayor for February shows that during the month 549 telegraph poles and 4,834 miles of wire were removed, of which the Department of Public Works removed 152 poles and 1,342 miles of wire, and the electric light companies the balance.

At the Aluminium Brass and Bronze Company's offices on Chambers street, this city, there are on exhibition a beautiful set of castings for the new Hotchkiss torpedo. On a test it was found that for long immersion aluminium bronze was the only metal that would do the work perfectly as required.

Messrs. Huebel & Manger, of 286, 290 Graham street, Brooklyn, still keep very busy, especially on their "L" iron box and "F" iron frame skeleton bells. They also manufacture a line of push buttons in bronze made in fancy styles that are just the thing where a very particular plant is being installed.

The Baehr Electric Company, of Brooklyn, is manufacturing a 100-ampère switch with a beautiful slate base that has a great many good features and is attracting considerable attention from central station superintendents. The Baehr company is now wiring the Eagle building for 1,000 incandescent lights.

The New York Carbon Works, offices 18 Cortlandt street, New York, have secured the sole right to manufacture carbon cylinders under the Holtzer patents in the United States. This right is very valuable, as it covers the manufacture of a carbon cylinder provided with a cover which is integral with it.

The Simplex Electrical Company has discontinued its New York agency heretofore held by Messrs. W. H. Gordon & Co., and until other and permanent arrangements are made Major D. T. Everts, the assistant manager, will look after the interests of the company in New York, with headquarters at the Imperial Hotel.

The Electric Construction and Supply Company, 18 Cortlandt street, New York, has made up for Liebmann Bros., the large retail dry goods dealers of Brooklyn, 130 special Ward lamps, covered with three coats of white enamel. These lamps, placed in the stores of the above company, surrounded by beautiful fabrics, will make an effect that is brilliant and dazzling.

P. & B. paint appliances, for covering, have been adopted by the government for protecting the wharf at the new torpedo station on Goat Island, San Francisco Harbor, after examination of all the other various modes of protection, including copper sheathing and creosoted poles. The Philadelphia City Board of Fire Underwriters make it a condition on inside wiring connections, moldings, etc., that they shall be protected by use of P. & B. paint.

Mr. J. W. Lattig, formerly superintendent of telegraphs of the Lehigh Valley Railroad, and more recently general superintendent of the National Switch and Signal Company, of Easton, Pa., has accepted the position of general superintendent of the Electric Secret Service Company, of New York, in especial charge of their telegraph and signal department. We are told that this company has a surprise in store for the railroad and telegraph worlds.

Telephone Legislation.—The efforts of the Telephone Subscribers' Association to have a bill introduced in the Legislature for better telephone rates have met with little success and as yet the bill has not shown up. The New York Board of Trade at its regular monthly meeting last week considered the subject of the unreasonable telephone charges being made by the Metropolitan Telegraph and Telephone Company for the use of its instruments, and adopted resolutions reaffirming its previous action and authorizing the appointment of a committee to co-operate with the Telephone Subscribers' Association in the effort to secure the passage of a measure of relief. L. H. H.

PHILADELPHIA NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
927 CHESTNUT STREET, PHILADELPHIA, March 12, 1892.

The Morton Safety Car Heating Company is meeting success in introducing its system into the street railway field. This This system is said to be very commendable from the point of view of safety, and is also a very economical mode of heating, as it utilizes waste steam.

Gill & Co., proprietors of the Washington Flint Glass Works, hold a foremost place among the manufacturers of electrical glassware. Their arc globes and incandescent shades, in point of uniformity of shape and quality of material, rank with any made, and are now used by many of the largest establishments in the country.

The Philadelphia Engineering Works, Ltd., has just shipped two 28 inch × 60-inch Philadelphia Corliss engines to St. Louis, to be used for driving the generators of the Benton & Bellefonte Street Railway Company. The engines are very massive in construction, the band wheels being 20 feet in diameter, 52 inches face, each weighing 70,000 pounds. They have also contracted for a 28 inch × 48-inch Philadelphia Corliss engine, to be erected in the power plant of the Southern Electric Light and Power Company of this city. W. R. W.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 28, Hathaway Building, 620 Atlantic Ave.,
Boston, Mass., March 12, 1892.

Col. Louis W. Burnham, of the Electric Gas Lighting Company, who has been on the sick list for several weeks, has gone to Virginia for a few weeks and will go from there to California.

Dissolution of Partnership.—The firm of Goodnow & Wightman, doing business at 63 Sudbury street, Boston, has been dissolved by mutual consent. The business will be continued at the same place by Luther H. Wightman.

The Boston Braid Manufacturing Company reports the demand for braided silk filaments to be constantly increasing. It is evident that the demand for high grade incandescent lamps is being fully appreciated, as is shown by the call for the filament.

Pettingell-Andrews Company are manufacturing a new incandescent lamp which they have called the "P. A.," and which is said to be very efficient, of long life and is selling well. Mr. H. F. Johnson, formerly with the Edison General Company, is at the head of the sales department. Mr. N. E. Dist will hereafter represent the Pettingell-Andrews company on the road.

Mr. J. W. Larish, electrician for the Western Union Telegraph Company, this city, has patented a very practical and desirable "Protector," which was given a practical test on a West End car last week and which proved in a high degree satisfactory. With this apparatus on a car there will be no burnt fuses, it is stated, and it is impossible to injure any part of the motor or car through the carelessness of motorman or otherwise.

Boston fire alarm wires are to be placed underground. Considerable trouble has been experienced by the Fire Department by reason of overhead wire, notwithstanding the fire-alarm wires have the right of way and preference of position on poles. During the past year the Fire Commissioners have made several improvements in the fire-alarm system in the direction of securing greater efficiency. The Commissioners have now decided to place their wires in Tremont street under ground. A cable will be run from City Hall across the Probate Court Building and down to Tremont street, where it will enter the conduit and connect with the fire-alarm wires. All the fire-signal boxes now in buildings will be placed upon lampposts on the sidewalk and connected with the wires, which will pass up though the hollow post with perfect insulation. A red lantern at the top of the lampposts will show the box number in white figures. As soon as this work is completed other sections of the city will be treated in a similar manner.

Boston's Society of Civil Engineers held its annual banquet Tuesday evening of this week, at the American House, President Frederic P. Stearns presiding. The following invited guests were present: Prof. Elihu Thomson, of the Thomson-Houston Company; President E. A. Capen, of Tufts College; Maj. W. R. Livermore, Engineer Corps, United States army; Col. H. G. Prout, editor of the *Railway Gazette*; E. C. Cabot, president of the Boston Society of Architects; H. G. Holden, president of the New England Water Works Association; S. C. Chandler, of the Boston Scientific Society, and Dr. H. P. Walcott of the State Board of Health. Several addresses were made, among which that by Prof. Elihu Thomson was especially interesting, referring to the many marvelous things that the electrical engineer was dreaming of, the probability of electrical motors superseding steam railway locomotives, the remarkable showings in electrical development, and the fact that traction was one of the great problems that was attracting the attention of the electrical engineer, as well as the long distance transmission of power.

The Manufacturers of Incandescent Electric Lamps will probably form a new industry in New Bedford, Mass., as a movement is on foot in that city to establish a factory for the purpose of manufacturing an electric incandescent lamp under a new patent, which it is claimed posesses many superior points of excellence. It is the invention of Herman J. Jaeger, an air pump manufacturer of Brooklyn, N. Y., who has had considerable experience in the laboratories of Edison and Maxim. Mr. Jaeger is the inventor of the mercury air pump now extensively used in exhausting electric incandescent light globes. Hearing of Mr. Jaeger's invention, Mr. Edward E. Bowker, of the Jenney Star Electric Company, invited the gentleman to come to New Bedford, with a view to establishing a factory for their manufacture. Mr. Jaeger and his brother Charles established a small experimental factory at the Jenney works. It is intended to demonstrate by actual manufacture the efficacy of the new invention. If New Bedford capitalists will put out their money there will be a company formed at an early date and a factory erected for its occupancy, or else the Jenney Electric Company will enlarge its plant to embrace the new enterprise. C. A. B.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
465 THE ROOKERY, CHICAGO, March 12, 1892.

John R. Markle, of Detroit, called on Chicago friends last week.

Mr. S. S. Leonard, of the Hill Clutch Works, Cleveland, O., was a Chicago visitor last week.

An Excellent Opportunity.—Agents desiring to secure a quick seller for the spring and early season should secure the Randolph motor.

Dr. Wm. M. Habirshaw, of the Indian Rubber and Gutta-Percha Insulating Company, of New York, was one of the welcome visitors in Chicago this week.

The Burton Electric Company's selling agents, the Electric Merchandise Company, of Chicago, have issued an attractive and interesting pamphlet on the subject of electric heating.

Mr. Elmer A. Sperry returned from New York this week and is hustling to fill the orders for the big mining locomotives and generators which the Sperry Electric Mining Machine Company are supplying to mining companies.

Dr. John and Mr. W. H. McKinlock returned to Chicago from Cuba just in time to feel the full force of Thursday's blizzard, which enabled them to more fully appreciate the generous warmth of the balmy breezes enjoyed on the Gulf Islands.

The Love Electric Traction Company, Chicago, has been running a car late at night over its electric conduit line on the Fullerton avenue loop, while awaiting the completion of the entire line. The promoters are well satisfied with the excellent results secured.

Mr. C. E. Wilson, well known from his connection with the Knapp Electric Works, has just made arrangements to represent the Electrical Merchandise Company, Chicago. Mr. Wilson's long experience and large acquaintance will make him a valuable addition to the staff of the company.

The Electricity Building is growing faster than any other structure on the World's Fair grounds, the carpenters now having nothing to impede their progress. In one day during the present week they put in construction 99,000 feet of lumber. The iron contractors have one more truss to set.

Mr. Alexander Kempt, the manager of the Chicago office of the Brush Electric Company, will receive his friends in a handsome suite of offices in the Monadnock building, corner Jackson and Dearborn streets, after May 1. Increased business necessitates the change to more convenient quarters.

The Siemens & Halske Electric Company's proposed plant may materialize before the end of July, as Mr. O. W. Meysenberg left for New York on Wednesday en route to Berlin. A suite of offices have been rented in the Monadnock building, adjoining the Union League Club, and will be occupied as soon as suitably furnished.

The Chicago Electric Club has arranged for a series of papers on subjects connected with the electric railway, as follows: March 21, "One Motor for Car Equipment." "Two Motors for Car Equipment." March 28, "The Gearless Motor," "The Single Reduction Motor." April 4, debate, "Resolved, We Should Have the Trolley System in Chicago."

H. G. Gessman, an electrician in the employ of the Edison General Electric Company, mysteriously disappeared Jan. 20 in St. Joseph, Mo., where he had been sent by the company to take charge of the Edison machines during the test on the People's Railway of the different makes of electric motors. Gessman went from Omaha to St. Joseph, where he had been for some time in the interest of the company. As soon as he arrived there he went to the office of the railway, and a little later he started to look for a boarding place. Since then he has not been seen or heard from.

For an Electric Plant at Riverside.—It is reported that Henry Villard's tract of 300 acres, at Twenty-second street and Riverside avenue in Riverside, formerly known as the Sturges Farm, will be purchased by the consolidated Thomson Houston and Edison electric light companies, and that if the deal is perfected a mammoth manufacturing plant will be established. It was reported that the Thomson Houston company, some months since, had nearly concluded arrangements whereby its plant would be established at Pullman, but the matter was dropped, and little has been done until recently, when the negotiations entered into with the Edison company revived the project.

The Chicago Society of Operative Electricians held their regular meeting in the rooms of the society, at 120 Quincy street, Chicago, Thursday evening, March 10. President H. G. Brownell presided, and after the routine business was disposed of the members listened to an interesting paper by Mr. S. E. Hitt, on "The Efficiency Test of an Electric Motor," which was followed by a paper on "The Amalgamation of Zinc for Battery Purposes," by Mr. G. M. Chamberlin, Jr. The discussion following the reading of these papers was participated in by Messrs. Cozzens, Connor, Carter, Dinsmore, Chandler, Wiltheim, Weinache, and others. An interesting paper is promised for the next meeting.

A Meritorious Promotion.—Mr. Lee L. Summers, late assistant electrician of the Western Union Telegraph Company, has accepted an important appointment in the Postal Telegraph Cable Company and will probably be the electrician of the entire western division. Mr. Summers planned and installed the extensive dynamo-electric plants of the Western Union Telegraph Company in Chicago and in St. Louis, and his extended experience in the utilization of dynamo-electric currents for telegraph lines, as well as in the general work that would fall to the electrician of the ever increasing lines of the Western Union Company, peculiarly fits him for the important work that will be placed in his hands.

Mr. S. G. Lynch, one of the oldest members of the Stock Exchange, who died Friday of last week, was widely known in financial and general business circles in this city. He served through the War of the Rebellion as an active aide-de-camp to Gen. Stager in the Department of Military Telegraphs. He was one of the constructors of the telegraphic cipher code used by the army and the authorities at Washington—a code which, it is said, has never been equaled in simplicity and ready adaptability while at the same time retaining its secrecy. One copy only of the code was captured by the Southern army, but the combinations were immediately changed, so the rebels gained nothing by their prize. At the close of the war Col. Lynch became private secretary to Gen. Stager when the latter assumed the office of General Manager of the Western Union Telegraph Company. Colonel Lynch, as he was

familiarly known, for some time past furnished the Chicago quotations of the Electrical Stock Market for THE ELECTRICAL WORLD.

Electric Lighting in Chicago.—Honest ambition and endeavor are always gratified by the appreciative notice of the great, and Chicago, eager to be accounted the best and purest of cities, ought to feel a thrill of pleasure at reading the remarks of an Eastern admirer on its electric lighting system. In the annals of the American Academy of Political and Social Science, Michael A. Mikkelsen, of Johns Hopkins University, declares not only that the electric lighting service of Chicago is the best in existence, but also that "the administration of municipal affairs in Chicago, perhaps more than in any other city of the first class, is conducted on business principles, being comparatively free from the influence of federal politics." We had never before duly appreciated our beautitude, but are glad to know our own virtues at last. Besides when one thinks of the matter, this city is pretty well lighted. We only think of the things that are done ill, not of those that are done well, and if any department of the public service is let alone by the press there could be no surer proof of its efficiency.—*The Chicago Journal.* F. DE L.

TACOMA, WASH., March 7, 1892.

An electric railway is once more talked of between Chehalis and Centralia, Wash.

The Postal Telegraph Company has opened its office for business in Everett, Wash.

An electric motor line from Mt. Vernon, Wash., to Anacortes, via La Conner, is being talked of by interested citizens.

G. H. R. Preble, formerly of Tacoma, has been offered the Northwestern Thomson-Houston Company's agency in Spokane.

The Waterville Improvement Company will place electric lights along the road between Wenatchee and Waterville, Wash.

The additional electric light equipment secured by the city of Vancouver is now being installed, and will be in operation by April 1.

Fred. E. Sander, of Seattle, has obtained a change of franchise allowing his Grant Street Electric Railway Company right of way through certain streets.

The Seattle Consolidated Electric Railway Company has taken the control of the Green Lake Electric Railway, in accordance with the terms of its lease of the latter road.

The Inland Telephone and Telegraph Company, of Spokane, through F. S. Shafer, superintendent of its Dayton division, has made arrangements for the opening of a telephone exchange in Dayton, Wash., April 1.

The Olympia Light and Power Company has raised $150,000 on its bonds. This insures the immediate construction of four miles of electric railway, extending through the city and terminating at Tumwater.

The Anacortes electric motor line from Anacortes to Fidalgo City, which now consists of 11 miles of rails and a power house, will be completed and put in operation when the money is received from its bonds, amounting to $125,000.

Baird Brothers, of Pullman, Wash., have closed a contract with the Edison General Electric Company for an 1,100-light central station plant, Edison three-wire system of distribution. The Edison General Company will also furnish the steam power plant.

A company has been formed in Oregon to utilize the water power of Pine and Rock creeks by electric transmission to Baker City, the distance being only 14 miles. The current will be used to operate the street railways, manufactories and electric lights.

The Washington Electric Company has been granted permission by the Seattle board of public works to continue stringing wires on the poles at present erected, on condition that there should be no interference with the police telephone system by induction.

President Kettenbach, of the Lewiston Bank, Lewiston, Idaho, has ordered from the Edison General Electric Company an arc and alternating electric light plant for his central station, which will be located at the water-works, two miles from the city.

Frank C. Ross, of Tacoma, is securing the right of way for an electric railway from Tacoma to Sumner, a distance of nine miles by the proposed route, which follows the north bank of the Puyallup River. A branch will connect the road with the town of Puyallup.

Manager R. S. Hill, of the Commercial Electric Light and Power Company, recently gave an "electrical dinner" at the Union Club in Tacoma. The guests were electrical and railroad officials, and "Electrical Possibilities" formed the subject of general discussion.

The Commercial Electric Light and Power Company, of Tacoma is extending its lines to reach the residence district in the northern part of the city. One hundred and fifty incandescent lamps in the Montello Hotel were recently connected with this company's circuits.

Anacortes, Wash., now has an electric lighting plant in successful operation, James F. McCann, being superintendent. The station equipment cost $30,000, including one 50-light arc dynamo, a 650-light incandescent dynamo and a Woodbury automatic engine of 125 h. p. capacity.

The Olympia Light and Power Company has awarded to the Northwestern Thomson-Houston Electric Company the contract for the electrical equipment of a power house and four miles of electric railroad, which will be constructed at once, extending from the East side to Tumwater.

The Fairhaven & New Whatcom Electric Railway Company recently put its through line into operation, extending from Harris avenue in Fairhaven, to Lake Whatcom. The trip from the Fairhaven terminal to New Whatcom is made in 30 minutes. Six cars are in use, giving a 15 minute service.

The Edison General Electric Company has contracted to install a 200-incandescent light plant in the Pullman roller mills, in Pullman, Washington, and has also taken the contract for building an extension of the present electric system of the Capital City Railway Company, of Salem, Ore. This extension will connect South Salem with all of the principal cemeteries, and the contract includes the erection of a large bridge across Mill Creek.

The Union Electric Company, capitalized for $1,000,000, which was recently organized as a result of the consolidation of the Seattle General Electric Company with the Home Electric Company, has elected the following officers: President and general manager, E. C. Kilbourne; vice-president, J. M. Frink; treasurer, C. P. Stone; secretary, J. T. Robinson; assistant secretaries, F. C. Dimock, of Seattle, and Augustus Rappard, of New York; assistant manager, A. L. Hawley; general superintendent, James A. McWilliams. Mr. Hawley now holds the same position with the new company which he formerly held in the Home company and Mr. McWilliams the same which he held in the General. T. H. Tyndale, manager of the Seattle General Electric Company, will remain in Seattle until the affairs of the old company are settled and will then go to Southern California. The transfer of the old companies' property to the new took place March 1. G. R. DE V.

ENGLISH NOTES.

LONDON, March 2, 1892.

TheElectric Railway Schemes.—There is a large number of petitions against the various electric railway schemes for London. Most of the petitioners, however, are only desirous of obtaining the insertion of clauses protecting their particular interests.

Municipal Lighting.—Deputations from Town Councils are almost daily visiting the Electrical Exhibition at the Crystal Palace. It is to be hoped they may see something which will cause them to at last drop the half-dozen deprecatory phrases with which they meet all electric lighting schemes.

Steam Pipes and Central Lighting Stations.—A breakdown, which recently occurred at a London central station, discovered a lamentable want of precaution in connection with the steam pipe system. Not only was the steam pipe system not duplicated, but it consisted only of a single length of pipe terminating in a blank flange with no return path to the boiler.

Electric Tramway Traction.—At the last meeting of the shareholders of the West Metropolitan Tramway Company the chairman made a statement which fairly represents the attitude which advocates of electric traction in this country have to encounter in 90 per cent., if not 99 per cent., of our tramway companies. The chairman said that the company had at last got the consent of the local authorities, who would, however, neither permit overhead wires nor a slot in the road. He would be glad indeed of some such system as the Lineff, *but he would not risk a farthing of the shareholders' money in any experiments.* If any electric company liked to come forward and offer to work the entire system at from 4½d. to 6d. per car mile, he would gladly hand the whole line over to them.

Sunspots and Magnetic Discharges.—In a recent communication to the Académie des Sciences, M. Janssen, the eminent French solar astronomer, stated that he saw nothing in the facts hitherto brought to light to warrant the hypothesis of there being any relation between sunspots and terrestial magnetic disturbances. He was not, however, prepared to dogmatize on the subject, but would prefer that inquiry should be made of foreign meteorologists if at the time of the fine aurora recently observed in America and Europe magnetic disturbances took place also in the Southern hemisphere. If it were thoroughly ascertained that nothing of the same kind took place in the Southern hemisphere, M. Janssen was of opinion that we should be in possession of a fact which would render the theory of solar influence a very improbable one.

The Specification of Insulation for Electric Lighting Conductors.—Although one or two members of our leading rubber and impregnated fibre firms took part in the lengthy discussion on Mr. Preece's paper, which was read before the Institution of Electrical Engineers in December, and which contained some novel suggestions in regard to the method of specifying for insulated cables, the majority of the speakers contributed their personal opinions rather than facts. Whatever may be the merits of Mr. Preece's suggestions, his paper has at any rate served a good purpose, inasmuch as it has brought prominently to the notice of the electrical industry that it is one of the most difficult things in the world to draw up a specification for an insulated cable and make sure that by fulfilling the letter of its clause the manufacturer will be obliged to supply the article required. It also came out that the majority of our consulting engineers are content to rely in childlike simplicity on the honor of the cable makers. The tricks of the trade are apparently as the sands on the seashore, for whatever searching test was suggested there was always a manufacturer's trick ready to circumvent it.

Telephone Legislation.—The opposition to the Bills of the National and New Telephone companies, now before Parliament, continues to grow. In both cases their rejection has been moved, and other members are proposing to refer the whole matter of telephone legislation to a select committee. It is highly probable that in the end the Post Office authorities will be forced at last to take up a decided position with regard to the telephone system of the country and be obliged either to purchase it outright or to legislate with that view. The National Telephone Company, as I have stated in previous letters, propose to obtain leave to run its wires pretty well where it likes, and how it likes. The real secret of the business has been pointed out by the leading financial-journal, the *Economist*, which shows that the National company has to pay dividends upon a capital that has been watered to the extent of over 50 per cent. Since the amalgamation of the telephone companies of the United Kingdom the dividends have indeed been restricted to 6 per cent., but to most of the shareholders this is equivalent to 15 per cent upon their original investment. "With such a showing as this," says the *Economist*, "it is ridiculous to put forward the plea that the company works under such peculiarly disadvantageous conditions in the metropolis that the present excessive charge for the service is justified, and that a reduction can only be made practicable if the company is granted the statutory powers asked for in the bill now before Parliament. In our view these additional powers should be withheld at all events until the National Telephone Company has shown itself willing to deal more fairly by its customers."

Inquiries from Correspondents.

Queries to be inserted in this column must be of general electrical interest, and must be accompanied by the real name and address, not necessarily for publication, but as a guarantee of good faith. No notice will be taken of questions which involve nothing more than can be found in elementary treatises on the subject. All correspondence should be as brief as is consistent with clearness. Readers are invited to send discussions and answers to these questions, which will be inserted in the column below.

[1.] What is the lowest frequency of alternation that is considered successful in electric lighting on an alternating system? I understand that it is the practice abroad to use a much lower rate of alternation than is the case with American makers. C. W. F.

[2.] When it is stated that the number of alternations is 200 per second does it mean 200 changes of polarity or 200 complete cycles? C. W. F.

[3.] In an alternating current system I have several times experienced a ground which was afterward cleared on the secondaries. In testing with a magneto at the station, the ground would ring on only one side of the line and would change at intervals to the other. Why is this, and why is it not the same on both sides of the line? SUBSCRIBER.

[4.] The resistance of the armature of an Edison machine is one one-hundredth of an ohm and that of the field magnet shunt coils is 17 ohms. What proportion of the current goes through the shunt? C. H. D.

[5.] In a recent case an electrician testified that electricity according to the best authorities traveled from 350,000 to 750,000 miles a second. What are the facts according to the best authorities? W. H. J. D.

[6.] The following two formulæ $H = \frac{2\pi ni}{r}$ and $H = \frac{4\pi ni}{\quad}$ occur quite frequently in S. P. Thompson's writings and also in other articles in your journal. The first it used when tangent galvanometers are discussed, the second is applied to solenoids without a core. Will you kindly show me by what changes they can be made equal to each other? G. M.

[7.] The following formulæ, $R = \frac{L}{d^2}10.61$, or $d^2 = \frac{21.21\ C\ D}{E}$, are found in "Hering's Wiring Computer." What is the constant 10.61 or 21.21, and in what way is it derived? E. W. C.

[8.] What is the nature of the action in a transformer when the secondary circuit is open which prevents the primary current, or at least all but a very small portion of it, from flowing through the transformer? E. W. C.

[9.] What is the principle on which the Slattery alternating volt or ampère meter works? E. W. C.

[10.] Would the static charge from a driving belt, if very sharp, injure the insulation of a wire on an alternating current armature or cause an open circuit in the same if the charge was not provided with some path to the ground? E. W.

[11.] How is it possible for the Weston voltmeter to have so low a temperature co-efficient as is claimed in their certificates? Platinoid has about double the temperature co-efficient claimed in the Weston instrument. C. T. L. M.

[12.] How can I frost and color incandescent lamp bulbs red by the use of collodion? J. H. D.

[13.] How large can a magnet be made, and how far can its powers be noticed, and what kind of wire is best for such magnets? G. K.

[14.] Can you tell me whether there is a fluid lubricant (not mercury) which is a good conductor of electricity, and which will not oxidize the bearings when not in use? Will a mixture of black lead and oil, or graphite and oil, constitute a good conductor of electricity when used as a luoricant? Does ordinary lubricating oil act as a non-conductor to the extent of completely breaking the current when used as a lubricant where it is desired to have the current pass through the bearings? M. W. H.

News of the Week.

THE ELECTRIC LIGHT.

Detroit City (Minn.) now has a new electric light system.

The Warsaw (N. Y.) Gas Light Company at a recent meeting of the directors decided to put in an electric plant. This will give the town two plants.

Reading, Middlesex County, Mass.—Solon Bancroft, E. B. Harrington and E. H. Gowing are a committee to consider and report on the question of a municipal electric light plant.

The Thomson-Houston Electric Company has just completed a contract with Little Falls, N. Y., having installed eighty 2,000-c. p. arc lamps for street lighting, and 1,000 incandescents.

Winona, Minn.—The City Council has granted a charter to the Thomson-Houston Electric Company and a plant is to be constructed at once for the purpose of furnishing light, heat and power.

The Brush Electric Light and Power Company, of Niagara Falls, N. Y., is arranging for extensive improvements in its station. A 600-light alternator will be installed during the summer.

Hamburg, Pa.—James H. Snell, of Snell & Meharg, is at the head of the movement for electric lighting and he has received promises of support from 200 citizens. He contemplates the formation of a stock company.

Menominee, Wis.—The contract for furnishing the entire plant of the Menominee Electric Light and Power Company, except the building and site, has been awarded to the National Electric Company, of Eau Claire.

Neenah, Wis.—The details have been perfected whereby George A. Davis, of this city, becomes the purchaser of the Neenah and Menasha gas and electric light plant, from Thomas Higgins, and also the electric light plant of E. F. Wieckert. The plants will be consolidated.

Flushing, N. Y.—The Flushing Electric Light Company has made application to the Flushing village trustees for an extension of its franchise with permission to enlarge the electric light service by the erection of additional poles and wires, and the application has been referred to the street committee.

The following towns are moving in the matter of having electric lights: St. Marys, O; Cuthbert, Ga.; Brenham, Tex.; Eagle Grove, Ga., Windsor, Mo.; Dunlap, Ia.; Madison, Ia.; Keyport, N. J.; East Concord, N. H.; Carlisle, Ky.; West Haven, Conn.; Hancock, Md.; Metropolis, Minn., and Hamburg, Pa.

The Deer Park Electric Light Company, of Port Jervis, N. Y., is placing additional power in its plant, in order to meet the demand for increased service. A new Russell engine is being installed, which will give a total of 335 h. p. The company is now supplying 100 arc lights and has facilities for 2,000 16-c. p. incandescents.

Findlay, O.—The City Council has granted a franchise to George B. Kerper and others, of Cincinnati, to operate an electric lighting and power plant in this city. A hot fight was made against granting this second franchise for electric lighting. Mr. Kerper, who is the principal owner of the Findlay electric railway, announces that his other two street railway lines in Findlay will at once be transformed into electric lines.

The Citizens' Lighting Company, of Far Rockaway, N. Y., has been granted a franchise by the board of trustees. It is expected to have the plant in full operation before the summer season begins. Arc lights of 1,200 c. p. and incandescent lights are to be supplied for private consumption. The officers and directors of the company are: Thomas Henderson, president; James Caffeny, vice-president; Benedict P. Smith, secretary, and David H. Jennings, recording secretary.

Will Not Renew the Contract.—Mr. Erastus Wiman, President of the Richmond County Light, Heat and Power Company, appeared before the New Brighton (S. I.) village trustees recently and announced that he could not renew the contract for lighting the streets of the village at the present rates. He stated that he contemplated a large power plant that would assure a satisfactory service, and admitted that the present service, about which there has been much complaint, was not satisfactory.

The Longmont Electric Light Company, of Longmont, Colo., has sold its plant to Denver capitalists, who have reorganized the company, and elected Frank P. Arbuckle president. The new title of the company will be the Longmont Electric Light and Motive Power Company, the intention of the owners being to also furnish motive power for running all kinds of machinery. A new dynamo has been ordered and the company will immediately adopt a three-wire system, which will allow it to supply arc and incandescent lamps.

Camden, Ark.—Although the electric light plant of the Cam-

den Electric Light and Power Company, Camden, Ark., was seriously damaged by fire on Jan. 24, steps were immediately taken to resume operation, and it was decided to equip a new and independent plant. Formerly the steam was secured from the waterworks boilers, but the company will now put in its own steam plant, having ordered two 60 in. × 16 ft. boilers, and a No. 7 Hoppes exhaust heater, from the Pond Engineering Company, through its Dallas, Tex., office. The engines, while considerably damaged, can be repaired.

The Electric Light Controversy, which has been in progress in Plainfield, N. J., since last November, has been adjusted. The experts in the employ of the Council at a recent meeting, it is stated, presented voluminous testimony to show that the city had been getting from the Plainfield Gas and Electric Light Company only two-thirds of the service for which it had been paying. Suit was to have been begun against the company to recover damages, or payment of street lighting bills was to have been withheld to the amount of the alleged deficiency; but on March 8 the Committee on Fire and Lamps succeeded in securing from the company a concession of the justice of the city's claim, and the Common Council authorized an adjustment of the matter by which the company forfeits on its bills for street lighting the full amount of damages claimed.

The Portland Electric Light Company, of Portland, Conn., has closed a contract with the Hunt Engineering Company, of New York, for the complete installation of an electric light and power plant in Portland, Conn., opposite Middletown, which will comprise the following: 200-h. p. steam plant; 1,000 light alternating machine; 35 light Ball; 1,200-c. p. dynamo and lamps; 80,000-watt electrical generator for power purposes. The Portland company has the contract for lighting the town for ten years with arc lights, and has subscribers to fill the 1,000 light alternating machine. The extensive brown stone quarry industries which are carried on in Portland will absorb the electrical generator for drilling, hoisting and pumping purposes, and it is the intention of the Portland Electric Light Company at an early date to increase the power capacity to 1,000 h. p. It is expected that the plant will be in operation on or about the first of July.

Indianapolis, Ind.—The contract which the board of public works is to make with the Brush company provides for the completion of the plant within six months from the date of acceptance, for 750 arc lights of 2,000 c. p., suspended on mast arms, the contracting company to have a trial period of 30 days. If at the end of the trial period the plant is satisfactory, the board of public works is to accept it. On the first day of January and July of each year the company, on a sworn statement of its gross receipts for six months, must pay into the city treasury two and a half per cent. of its net receipts from the time this contract takes effect. After Jan. 1, 1896, the percentage of this payment is to be five. This payment applies to gross receipts from all sources. The city is also to be saved from liability and a bond is therefore required of the company in the sum of $50,000. The city is to pay the company $85 for each arc light per year on moonlight schedule, and $90 on all-night schedule. The term of the contract is to be 10 years.

ELECTRIC RAILWAYS.

Buffalo, N. Y.—The car barns of the Street Railway Company have been burned.

Plainfield, N. J.—The Plainfield Street Railway Company will at once begin the construction of their proposed trolley road.

Skowhegan, Me.—K. W. Haines, of the Hotel Coburn, is interested in the proposed electric road from this place to Madison Bridge.

Jacksonville, Fla.—Dr. H. K. Rainey is urging the building of a belt electric road in this town, but nothing definite has yet been done.

Mount Vernon, N. Y., has voted against the proposition to give a franchise to the Yonkers & Mt. Vernon Electric Company to lay tracks in the village.

The Niagara Falls and Suspension Bridge Street Railway Company has contracted for an electrical equipment for its lines, to be in operation by July 1 of this year.

Newton, Mass.—The Newtown board of aldermen is discussing the petition of the Newton & Boston Street Railway Company for right to locate tracks at Newton Highlands.

Pittsburgh, Pa.—The Duquesne Traction Company has decided to extend its tracks out Lincoln avenue across the bridge to Leamington avenue, a distance of three-quarters of a mile.

McKeesport, Pa.—The McKeesport *Herald* claims to have information of an electric railway project which contemplates a road from McKeesport to Elizabeth, but no details have as yet been given.

Denver, Colo.—The Denver, Lakewood & Golden line is to be operated by electricity by April 1. The overhead system will be used, it is stated, and not by electric engines, as has been reported.

The Benton-Bellefontaine Street Car System, of St. Louis, Mo., which is being equipped with electricity by the Thomson-Houston company, it is stated, will be completed and in operation by April 1.

South Creede, Colo.—A new electric street car line is to be completed within 20 days between South Creede (Jimtown) and Creede a distance of 2½ miles. It is being built by the South Creede Land and Investment Company.

Zanesville, Wis.—Stockholders of the Zanesville Electric Street Railway Company have decided, it is stated, to invest $100,000 in equipping the system, instead of $40,000 as first intended. Seven miles of road will be equipped.

Lowell, Mass.—The board of selectmen of Chelmsford, near here, have given a hearing to the petition of the Lowell & Suburban Street Railway Company for right to extend their tracks to that part of the town, but no definite action has been taken.

The Roanoke (Va.) Street Railway System is to be equipped electrically. The improvements contemplated will necessitate an expenditure of about $150,000. The road has recently passed into the hands of a new company, of which Mr. S. W. Jamison is president.

A Trolley Road in Russia.—The first electric street railway in Russia, it is stated, will be constructed in the city of Kiev, situated on the river Dnieper. It is a place of about 130,000 inhabitants. The trolley system will be used and the road is to be in operation this summer.

Fond du Lac, Wis.—The Fond du Lac Electric Company, capital $100,000, recently formed, will purchase the franchise of the defunct Fond du Lac Street Railway Company and operate an electric road, and it will also equip an incandescent electric lighting plant and furnish power.

Boston's New Electric Cars.—Electric cars are now running between Harvard Square, Cambridge, Park Square and City Point, South Boston, via Dover street. Large eight-wheel cars have been placed on the route, and the new system is said to be giving great satisfaction to West End patrons who have use of the lines in that section.

Long Island City, N. Y.—The Brooklyn City Railroad Company is endeavoring, it is stated, to purchase Mayor Gleason's electric railroad connecting the suburbs of Long Island City with the Thirty-fourth street and James Slip ferries. The price offered is said to be $500,000, which was declined. There are nine miles of electric railroads now in operation owned by Mayor Gleason, valued, it is said at $800,000.

Millbury, Mass.—F. A. Gaskill, on behalf of the Consolidated Street Railway Company of Worcester, is before the Council with an application for a franchise for a road to connect this place and Worcester, and a local company, called the Worcester & Millbury Electric Railway Company, has also made application. Among those interested in the latter scheme are Hon. Samuel Winslow, George S. Hoppin, Thomas F. Robinson, L. L. Whitney, W. B. Ferguson and C. D. Morse.

The Buffalo, Bellevue & Lancaster Railway Company, of Buffalo, N. Y., has signed a contract with the Field Engineering Company, of New York, it is stated, for the entire electric equipment of that road between Buffalo and Lancaster. The preliminary surveys are now being made. The work of constructing the road will be begun immediately, and is to be completed in 60 days. There will be seven miles of railroad, the cost of which, including the power, will be about $100,000.

Janesville, Wis.—John A. Barham, President of the Janesville Street Railway Company, Janesville, Wis., has contracted with the Chicago office of the Pond Engineering Company for the complete steam plant necessary to operate his road by electricity. The plant includes a 14 × 13 Armington & Sims engine, with foundation box; 66 × 16 steel boiler, with stack, and the usual fittings; a No. 3 Blake boiler feed pump, and a No. 5 Hoppes exhaust heater. The Pond company's contract also includes delivery and erection of this machinery in Janesville, with foundations, brick work, pipe connections, etc., all ready for service.

The Reliance Electric Manufacturing Company, of Waterford, Ont., who are building the Rae system in Canada, have secured the contract for the equipment of the Toronto & Mimico Electric Railway. This road will start from the terminus of the Toronto City Railway Company's lines on Queen street and extend to the village of Mimico and eventually to Long Branch, a total distance of about seven miles. The road runs along the entire distance of the lake shore. The Reliance company has the contract for the entire equipment, exclusive of track. The power station will contain one Armington & Sims engine of the compound condensing type, 125 h. p., and the Rae station electrical apparatus, consisting of one 85 k. w. generator and necessary appliances. The motors for this road are of Mr. Rae's latest design of single reduction motors.

The Dubuque (Ia.) street railway lines are to be equipped electrically, the contract for the overhead construction, dynamos and motors having been let to the Edison company, the motors to be the Rae patent, manufactured by the Detroit Electric Company. The J. C. Brill company, of Philadelphia, the same company which furnished the cars now operated by the storage batteries, has been given a contract to furnish six new motor cars. The nine cars made by this company and now in use will be altered so that they can be operated by the trolley system. The new cars will be similar in construction, will be 16 feet long—2 feet longer than the old cars. The company will have an equipment of 15 of the handsomest motor cars manufactured. In addition to this a contract has been made with the St. Louis Car Company. Six of the Rae motors, with which the motor cars will be equipped, will be of 40 h. p. each, and the others of 30 h. p. There will be but one motor on each car. The Edison company will furnish two dynamos, the combined energy of which will equal about 134 h. p. The company already has a powerful dynamo, which is used to charge the storage batteries, and this and a third dynamo, to be purchased hereafter, will be added to the equipment. A new Corliss engine of 500 h. p. will be installed in addition to the 325-h. p. engine of the same make now in operation. Additional boilers will be ordered. Iron poles set on the curbs at either side of the street, 125 feet apart, will carry the trolley wire. President Rhomberg stated that the various contracts were made with provisions that all material should be on hand and the overhead construction be completed within 60 days, and that the equipment of the entire line will be completed by May 15.

MISCELLANEOUS NOTES.

An Electrical Subway Commission.—A new commission authorized by a law passed at the present session of the New Jersey legislature has just been appointed by Gov. Abbett.

Electrical Treatment of Sewage.—In a comparison made by an English contemporary it appears that the cost of the electrical treatment of sewage is about $18 per million gallons, which places it fifth in the order of cost as compared with other systems.

Accumulator Cars in Rome.—Some experiments have recently been carried out in Rome with accumulator cars of which the electrical apparatus was supplied by the Oerlikon company, of Zurich. The cars attained a speed of 19 miles per hour. One charge of the accumulator will make a 94-mile run, and as each car runs only 47 miles a day at an average speed of 7½ miles an hour, they need be recharged only every second day.

An Electric Light Plant Burned.—The electric light plant at Martin's Ferry, O., was destroyed by fire recently. The plant was owned by the Martin's Ferry Construction Company and contained some valuable machinery. It furnished power to the street car line, which will have to discontinue operations until the plant is rebuilt. The loss is estimated to be from $20,000 to $25,000; insurance, $15,000.

The Electrical Execution Bill.—The bill introduced by Assemblyman M. J. Stein doing away with electrical executions and returning to the rope has been reported upon favorably by the Codes Committee. Elbridge T. Gerry, one of the commissioners who secured the passage of the present capital punishment law, defends electrical executions in recent interviews in regard to the proposed change, claiming that the present system has demonstrated its usefulness and possesses all the advantages claimed for it.

Industrial and Trade Notes.

The Automatic Switch Company, of Baltimore, will soon introduce a new rheostat to the electrical trade.

The Taylor Manufacturing Company, of Chambersburg, Pa., has just completed a new type of compound engine.

Aug. Wolf & Co., of Chambersburg, Pa., who are extensive manufacturers of water wheels, report business as being particularly good.

S. Morgan Smith, of York, Pa., has received some very large orders from his agents in Moscow, Russia, for turbine water-wheels. They are now introducing a new type.

The Washington Construction Company (Pardoe and Messner), of Washington, D. C., have closed a contract with the borough of Lewisburg, Pa., to furnish the town with arc and incandescent lighting for a term of five years.

The Interior Conduit and Insulation Company, 44 Broad street, New York, is sending out a very attractive catalogue, illustrated and descriptive of the special line of the switches, particularly the Johnson switch, which the company manufactures.

The Jenney Electric Company, of Indianapolis, Ind., has shipped to Michigan City a 50-h. p. motor to be used in a submarine torpedo boat which is being built for government use by Chicago capitalists. This is an entirely new thing in submarine navigation, and will be tested by the government in about three weeks. It is, like most other craft of its kind, cigar-shaped, but is controlled by entirely new methods.

Milliken Brothers, of 55 Liberty street, New York, have sent out a neatly compiled pamphlet containing information for electrical engineers and builders of electric street railways and electric lighting plants. Milliken Brothers are extensive manufacturers of poles for electric street railway and electric light work, and report an extensive demand for the same. They have recently made arrangements with parties in England, France and the Continent to manufacture these poles abroad for the European trade.

The Electric Appliance Company, of Chicago, is now introducing something new in the line of a combination branch block. As at present constructed it is adapted, it is stated, for eight circuits, although other sizes are in course of construction. In size it is about eight by twelve inches, made of hard porcelain with highly polished oak or cherry cover. It can be placed in a wall or other suitable place, requires but very little space, and when connections have been made the cover is fastened on by screws, making a very neat and substantial job. This block is meeting with general approval, it is stated, among construction men.

The Wainwright Manufacturing Company, of Massachusetts, has recently secured the contracts for feed-water heaters in the following plants: Lynn & Boston Railway Company, Lynn, Mass.; New York Electric Railway Company, New York, N. Y.; Twin City Electric Railway Company, Minneapolis, Minn.; Aurora Street Railway Company, Aurora, Ill.; Arlington Mills, Lawrence Mass.; Howland Mills, New Bedford, Mass.; Globe Street Railway Company, Fall River, Mass.; Rotch Spinning Company, New Bedford, Mass.; Pottsville Electric Light Company, Pottsville, Pa.; New York & Pennsylvania Company, Johnsburg, Pa.; McCormack Harvesting Machine Company, Chicago, Ill. These contracts aggregate 27,000 h. p. The growing demand for the Wainwright improved corrugated copper tube feed-water heaters shows what persistent energy and reputation for making first class goods will do. There are now over 300,000 h. p. of these heaters in successful operation.

Mr. C. E. Sargent, manager of the Chicago office of A. L. Ide & Son, has received the following orders for Ideal engines since the beginning of the year: E. W. Blatchford, one 55 h. p. for incandescent lighting; Winslow Brothers, one 35 h.p. for electroplating; the Sperry Electric Mining Machine Company, one 100 h. p. for an electric haulage and mining plant; Groveland Apartment Building Company, one 35 h. p. and one 55 h. p. for incandescent lighting; Hyde Park Electric Light and Power Company, one 250 h. p. tandem compound for arc lighting; Thomson-Houston Electric Company, two 125 h. p. engines and a complete plant for an electric railway; the National Electric Manufacturing Company, two 100 h.p. for an alternating incandescent plant, and the Bavarian Brewing Company, one 35 h. p. During the past week, two 80 h. p. Ideals have been placed in the Unity Building for incandescent lighting; three 100 h. p. Ideals in the Ashland Block for incandescent lighting; one 100 h. p. in the Arc Light and Power Company's Market street station; one 55 h. p. in J. S. McDonald & Company's new factory for incandescent lighting, and one 100 h. p. and one 150 h. p. in the Grant Locomotive Works for lighting and furnishing power for three electric cranes.

Harrisburg Ideal Engines for Steamboat Service.—During the past few months, W. R. Fleming & Co., of 174 Fulton street, New York, have been equipping a number of steamboats with their Ideal self-oiling automatic cut-off engines for running the electric lights. This is the engine which, it is stated, has been meeting with such success in hotel and apartment house service in this city and elsewhere. It has been found just as satisfactory, it is said, in steamboat service, as can be shown by the long list of boats now being equipped with these engines. The first boats which used them were the Ward line steamers Yumuri and Maverick, which have been followed by those of the Pacific Mail Steamship Company's boats, Havana, Armeria, Newport, Para and Rio Janeiro, besides one not yet completed at Chester, Pa., and another at San Francisco, Cal., for which the engines have just been shipped. The Pennsylvania Railroad Company is using the same engine on its new ferryboats New Brunswick, Cincinnatti and Chicago. The Spanish steamship line is using them on its steamers Savannah and Ciudad Condal plying between New York and Cuba these being coupled direct to multipolar dynamos, both engine and dynamo resting on the same base, a very satisfactory arrangement

Queen & Co.'s Testing Sets.—We are informed by Queen & Co., of Philadelphia, that their portable testing resistance sets still meet with great favor wherever they are introduced, and that the new style known as the "1891" type, which was brought out last fall, is especially appreciated, as its peculiar construction has overcome many previous difficulties in both outside and inside testing. Heretofore considerable trouble has been experienced with the galvanometers usually supplied for such work, those with fibre suspension being too delicate for street use or where running machinery jars the station, and those moving on a central point being too sluggish. To overcome these defects Queen & Co. devised a new galvanometer which, it is stated, meets the requirements of all-around testing to a most satisfactory degree. The features of this instrument are deadbeat quality and sensibility. In consequence it is not affected by mechanical vibrations and proximity to masses of iron or intense magnetic fields, and can be used alongside of dynamos when running, in the streets of large cities, on shipboard and in fact everywhere. The makers claim that no other galvanometer is adapt to such universal use. The coils in the rheostat and bridge are wound with platinoid wire and guaranteed accurate to one-fifth of one per cent. A special "reversing attachment," employed by Queen & Co. in their standard resistance boxes, is supplied which gives a maximum range from .001 to 11,110,000 ohms. The makers have just issued a neat circular No. 285, which sets forth the advantages of their testing sets, and they will gladly send a copy of the same to interested parties.

Business Notices.

Battery Cut-Out, Cheap.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

The Mather Electric Motors combine the highest efficiency and workmanship consistent with a reasonable first cost. Perfect automatic regulation of speed from no load to full load. For catalogue and information address E. T. Pardee, agent, 14 Butler Block, Syracuse, N. Y.

In our advertising pages this week will be found an illustration of the well known and popular Partrick & Carter Co. patent needle annunciator. This firm are the only makers of the original needle annunciators which are made under United States patents of recent date, which do not expire for some years. The features and advantages of this annunciator are too well known to require an extended notice. They are made up in various styles of cases and woods, with or without return calls and fire alarms. Descriptive catalogues and price lists will be sent to the trade upon receipt of application and business card.

The Electric Supply Company, of Syracuse, N. Y., through Mr. Jervis Myers, manager, states that the battery cut-out, the device of A. L. Clough, of Boston, which was described in THE ELECTRICAL WORLD of March 5, is an infringement of the one placed upon the market by the Electric Supply Company, which was described in THE ELECTRICAL WORLD, June 28, 1890. The instrument at present manufactured by this company uses a fluid, but the manufacturers have used and have intentionally broadened their patent to cover the use of a rolling ball, the same as is described in the device brought out by Mr. Clough. It is the intention of the Electric Supply Company to protect its interests

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

U. S. PATENTS ISSUED MARCH 8, 1892.

470,194. Electric Motor of Dynamo-Electric Machine; Henry H Hosford, of Cleveland, O , Assignor of one-half to Charles W. Foote, of same place. Application filed June 4, 1891. A dynamo-electric machine or electric motor having a rotary field magnet and a stationary ring armature provided with laminated core pieces bolted together and to sustaining or side supports with a fixed commutator composed of conducting bars or strips having an angular relation to the commutator brushes and their holders.

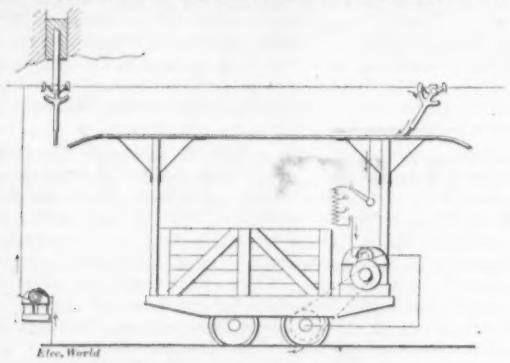
470,199. Electric Motor or Generator; Rankin Kennedy, of Glasgow, Scotland. Application filed Sept. 24, 1890. In an electric motor or generator, a field magnet, two independent windings upon said field magnet, and two independent synchronously rotating commutators connected respectively with said windings, in combination with a generator which transmits to each of said commutators an independent alternating current of like periodicity, but of dissimilar phase, which alternating currents are rectified by said commutators into pulsating uni-direction currents before traversing the independent field windings respec tively connected thorewith. (See illustration in which *A* is a diagram elevation of an ordinary motor operated by a single line current. *B* and *C* taken together constitute a diagrammatical end view and elevation at right angles to each other of a motor constructed in accordance with the specifications of this patent.)

470,204. Electric Cut-Out and Safety Device; Charles R. Meston and Alexander W. Meston, of St. Louis, Mo., Assignors to the Emerson Electric Manufacturing Company, of same place. Application filed Jan. 12, 1891. In an electric cut-out, the combination, with a base block having projecting contact pieces and a projection or ridge, of a detachable cover having projecting contact pieces adapted to take under the contact pieces of the base block, and an interposed spring tongue arranged to engage with the ridge or projection on the base block when the contact pieces are in juxtaposition.

470,217. Connection for Armature-Conductors; George Stephens, of Lynn, Mass., Assignor to the Thomson-Houston Electric Company, of Connecticut. Application filed Nov. 13, 1891. The combination of the bared portions of the armature conductor and connecting conductor, a sleeve around same, and a clamp supported by the armature and clamping said sleeve.

470,221. Electric Railway; Elihu Thomson, of Lynn, Mass., Assignor to the Thomson-Houston company, of Connecticut. Application filed Oct. 9, 1889. The combination with an electric line of a series of pivoted contacts normally out of electrical connection therewith and each pivoted to swing either forward or backward in the direction of movement of the vehicle and of a length slightly greater than the distance between the successive projecting contacts and adapted to engage with them in succession, and electric switches, the contacts of which are mounted on suitable supports, which are engaged by a part moving with the vehicle, and are thereby moved positively into circuit-closing position, so as to establish electrical connection between the line and the series of projecting contacts as the elongated contact bar or plate makes connection with the projecting contacts. (See illustration.)

470,231. Fire Alarm and Telephone Apparatus; Edward H. Amet, of Chicago, Ill., Assignor to himself and Herbert A. Streeter, of same place. Application filed July 26, 1890. A combined telephone and fire alarm signaling apparatus comprising a telephone and telephone circuit, an automatic fire alarm



No. 470,221.—ELECTRIC RAILWAY.

signaling device, a thermostat and its circuit, including a magnet, and an induction coil circuit having a secondary circuit adapted to be included in the telephone circuit, the magnet in the thermostat circuit operating to cut out the telephone and throw the secondary circuit into connection with the telephone line, so that the signaling device may send a signal to the signal receiving instrument at the central office in case of fire.

470,237. Conduit for Electric Wires; Charles A. Freeman, of Steubenville, O. Application filed Sept. 25, 1891. A conduit for electric wires, formed of a series of tubular section tiles having longitudinal partition walls extending through the same, the ends of the outer walls of said tiles having tongues and grooves formed within their walls and arranged to bring the outer walls and inner partition walls of each tile into coincidence with its counterpart, and to lock it against lateral or vertical displacement.

470,256. Electric Gas Lighting Burner; Horace A. Pinkham, of Wollaston, Mass., Assignor to George F. Pinkham, of same place. Application filed Sept. 25, 1891. In an electric gas lighting burner, the combination, with the fixed electrode and a movable electrode, of a cam for actuating said movable electrode, said cam having two inclines, one outside the other, extending upward in opposite directions and adapted to act alternately upon said movable electrode.

470,260. Electric Battery; Vincenzo Riatti, of Milan, Italy, Assignor to Julian Goldsmid, of London, England. Application filed June 9, 1891. A thermo-electric cell, consisting of a vessel made of material which is a bad conductor of heat and electricity, charged with liquid capable of conducting electricity, and having an electrical conductor at the bottom and a heating and conducting body at the top of the liquid.

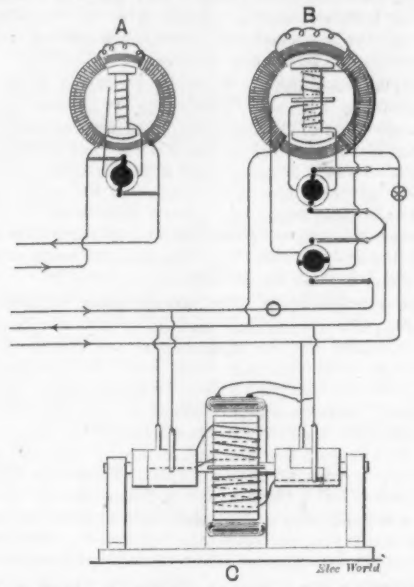
470,329. Underground Conduit for Electric Cables; Carl Axel Wilhelm Hultman, of Stockholm, Sweden. Application filed June 9, 1891. In combination with the conduit block for electric cables or wires, metallic bars or tubes lodged in exterior longitudinal grooves in said block, and the adjacent ends of the sections of such blocks wrapped with a cloth prepared with melted asphaltum, and the cloth and block ends covered with cement or some flexible compound.

470,340. Movable Coil for Electrical Measuring Instruments; Edward Weston, of Newark, N. J. Application filed March 11, 1891. An insulated coil conductor, having numerous turns cemented together to form a compact annular body, and provided with pivots.

470,341. Electrical Measuring-Instrument; Edward Weston, of Newark, N. J. Application filed June 4, 1891. The combination, in an electrical measuring-instrument, of a fixed coil, a movable coil supported in front of one face of said fixed coil, a rotary index needle, and transmitting mechanism between said movable coil and the index, whereby the movement of the movable coil due to the passage of a current through said coils is transmitted to and causes a rotary movement in said index. (See illustration, in which *A* is a front view of the instrument, B and *C* are sectional views and *D* is a side and partial sectional view showing a modification of the instrument in which two coils and a single stationary electromagnet are employed instead of one coil and two electromagnets.)

470,356. Insulator for Overhead Electric Railways; Henry D. Winton, of Wellesley, Mass., Assignor to the Hersey Mfg. Company, of Portland, Me., and of Boston, Mass. Application filed Oct. 22, 1891. An insulator for overhead electric railway trolley wires, composed of an insulated body portion formed to shed rain or moisture and having at its extremities projecting studs formed to receive interchangeable attaching pieces for clamping the trolley wire and securing the insulator to supports.

470,372. Push-Button; Charles H. Delano, of Woburn, Mass. Application filed June 2, 1891. The combination, with the case and fixed contact pieces applied thereto, of the push piece, contact plate applied thereto having oppositely disposed inclined wings for sliding or rubbing engagement with the fixed contact pieces, and a spring acting to press the push piece outward.



No. 470,199.—ELECTRIC MOTOR OR GENERATOR.

470,382. Safety Cut-Out; Max Kerstein, of Boston, Mass. Application filed June 8, 1891. The combination, with an electric wire composed of sections and provided with slip joints to connect the sections, of supports for the said sections; wire and springs connected at one end to one of the supports and at the other end to one member of the said slip joints.

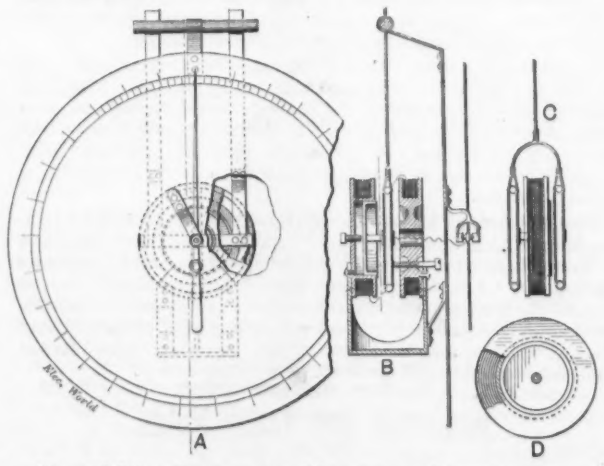
470,402. Regulating Socket or Holder for Incandescent Electric Lamps; Elias E. Ries and William Smith Horry, of Baltimore, Md., Assignors to the Ries Electric Specialty Company, of the same place. Application filed May 5, 1891. A socket for incandescent electric lamps operated by alternating or intermittent currents, comprising an iron ring or core wound with a strand or cable composed of a number of separate insulated wires, a non-conducting support for the said core, having a series of contact terminals, to which the ends of the wires composing the strand or cable are connected, a contact making holder or receptacle for the lamp, also secured to said support, a key or switch suitably mounted in said support and arranged to make contact with the said terminals, and a shell surrounding said support, and inclosing the coil, the contact terminals, and the lamp holder or receptacle. (See illustration on page 201.)

470,417. Insulator for Trolley-Wires; William S. Andrews, of New York, and Henry Price Ball, of Brooklyn, N. Y., Assignors to the Edison General Electric Company, of New York. Application filed Oct. 1, 1891. The combination of the insulating-body consisting of a block of wood having a groove or depression at one end, a metal bell into which the body is placed, the metal of the bell being formed into said groove or depression, whereby the body and bell are secured together, and means at the other end of the insulating-body for supporting a wire.

470,418. Electrically Heated Oven; John V. Capek, of New York, Assignor of one-half to Edward H. Johnson, of same place. Application filed March 21, 1891. The combination of a holder, an electrical heater having a heating or supporting plate, and an insulated heating-conductor, said plate fitting into the holder and said holder being constructed with inwardly extending edges to hold it without separate securing devices.

470,419. Electric Oven; John V. Capek, of New York, Assignor of one-half to Edward H. Johnson, of same place. Application filed Aug. 14, 1891. The combination of an oven which is bodily movable, a stationary electric heater therein, the walls of the oven extending by the heater, whereby the oven may be moved away from the heater to enlarge the heating chamber without uncovering the heater.

470,428. Electric Store Service Apparatus; Midbury W. Hassan, of Rochester, N. Y. Application filed Feb. 2, 1891. The combination, with two parallel wires in an electric circuit, forming a track, and a carrier running thereon, of an insulator at one or both ends imbedded in the wire without cutting off its continuity, said insulator serving to receive the carrier and cut off the circuit therefrom.



No. 470,341.—ELECTRICAL MEASURING INSTRUMENT.

470,441. Electric Current Meters; Johan W. Th. Olán, of New York, Assignor of one-half to Edward H. Johnson, of same place. Application filed June 6, 1891. The combination in an electric meter, of a vessel containing a liquid, a balanced float in said vessel and movable therein, said float having a forward movement only while the meter is in use, means for disturbing the balance in accordance with the current measured, so that the float will move, and a recording mechanism operated by the movement.

470,455. Magnetic Ore Separator; Charles T. Thompson and Richard H. Sanders, of Philadelphia, Pa. Application filed April 16, 1891. The combination of a rotatable hollow drum having a substantially non-interfering wall, a stationary magnet whose poles closely envelop a portion of the exterior periphery of said drum, and a chute arranged within the drum beneath the upper limit of the magnetic field.

470,456. Magnetic Ore Separator; Charles T. Thompson and Richard H. Sanders, of Philadelphia, Pa. Application filed Dec. 5, 1891. The combination of a rotating drum having a substantially non-interfering wall, with a plurality of stationary electromagnets, a plurality of chutes respectively extending from beneath the upper limits of the several fields by different delivery points, and means whereby the energy of the fields of one or more of the magnets may be varied.

470,471. Incandescent Electric Lamp; Augustus C. Carey, of Lake Pleasant, Mass. Application filed Aug. 3, 1891. In an electric light lamp, leading-in or circuit wires, an incandescent filament, and a joint therefor composed of a double tube in which the ends of the filament and leading-in or circuit wires are secured.

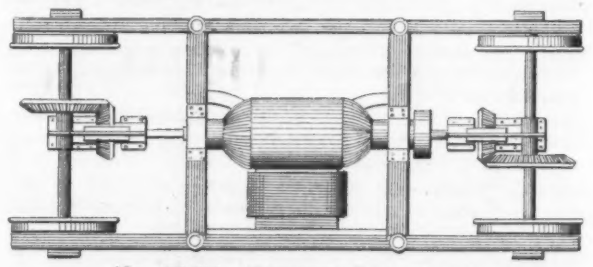
470,478. Automatic Heat Signaling Device; Willard G. Day, of Baltimore, Md. Application filed March 18, 1891. In an automatic fire alarm apparatus, the combination of a windable call mechanism controlled manually and by a warping thermostat having a pin, which in the normal position of the thermostat engages with some part of the windable call mechanism, and thereby prevents its operation, but which upon the warping of the said thermostat is withdrawn from the said mechanism and allows the same to run down and give an alarm.

470,505. Electric Car-Brake; John Redmond, of Seattle, Wash. Application filed Oct. 17, 1891. In an electric-brake system for railway cars, the combination of the generator, the circuit wires connected therewith, a circuit closing key or lever located in the cab, an electromagnet carried by each car and having pivoted armature-lever, said magnet forming a part of the circuit, connections between said lever and the brake-shoes, whereby the latter will be applied when the magnets are energized, and couplings for the circuit wires between the respective cars, comprising the spring to which said wires are connected, the removable conductor-plugs engaged thereby, the insulator-strip separating said plugs, and wires connecting the respective plugs in adjoining cars.

470,514. Lightning Conductor; Harvey Simpson, of Kenosha, Wis. Application filed Sept. 9, 1891. In a conductor, hollow adjacent main sections, a pipe section surrounding the meeting point of the said main sections, and indentations formed in the said pipe section, which extend into the main sections.

470,516. Electric Locomotive; Elmer A. Sperry, of Chicago, Ill. Application filed June 11, 1891. In a power-gearing for electric cars, an electric motor, a hollow armature shaft for the motor, a power-transmitting shaft within the armature shaft connected by gearing to the car-axle, an elastic or cushion connection between the two shafts, and a rigid frame for the motor elastically supported from the truck-frame, whereby the motor may be located between the axles and permitted to vibrate independently of such axles. (See illustration.)

470,521. Electric Generator; Charles J. Van Depoele, of Chicago, Ill., Application filed May 13, 1887. A system of generating and distributing electric currents, comprising a separately excited generator of the continuous current type, the armature of which is connected with the working circuit, an exciting generator, also of the continuous current type and having primary or main field magnet coils and connected directly to and delivering its normal output through the field magnet coils of the generator, magnetizing the same so as to produce the initial potential in its armature, and additional reinforcing coils upon the field magnet of the exciter, said coils forming part of the working circuit and acting to increase or decrease the total output of the exciter and correspondingly affect the field of force of the main generator in accordance with the consumption of current in the working circuit.



No. 470,516.—ELECTRIC LOCOMOTIVE.

470,552. Galvanic Battery; John H. Davis, of Detroit, Mich. Assignor to the Electrical Fiber-Carbon Company, of same place. Application filed April 24, 1891. In a battery jar, the combination of an outer flexible vessel and inner flexible vessel of less diameter than the outer vessel and rendered impervious to moisture, and a filling located between the adjacent walls of the vessels.

470,557. Telegraph Relay; Charles M. Dyer, of Cloverdale, Ind. Application filed Sept. 9, 1891. The combination, with an armature lever pivoted at one end at right angles to the magnet and provided with a spring projecting beyond its front face toward the magnet, of an armature mounted on the inner end of the spring adjacent to the magnet.

470,566. Machine for Heading Spokes; Thomas Hill, of Quincy, Ill., Assignor to the Electric Wheel Company, of same place. Application filed Nov. 22, 1890. In an electric machine for securing the spokes to the rim of metal wheels, etc., the combination of the lower contact-plate, an upper contact-plate, and means for moving the upper plate, consisting of a hollow threaded shaft supported in a threaded bearing and receiving a stem on the upper end of the plate and a lever pivoted to said shaft and having a cam bearing on the upper end of said stem.

470,596. Electric Circuit Closer; George W. Price, of Baltimore, Md. Application filed Nov. 18, 1889. In a circuit closer, the combination of a coiled spring secured to a block as one end of the base, and having a straight extension passing through an opening in another block and having a loop at its extremity, and a spring contact piece secured to the first block and curved upward at its free end, the curved portion lying in the line of extension of the coiled spring so that when the same is extended electrical contact will be made with the contact piece and the circuit closed.

470,627. Electric Locomotive; Sidney P. Hollingsworth, of Washington, D. C. Application filed Dec. 15, 1891. In an electric locomotive the combination of a continuously running motor, the vehicle, wheels and axle, a clutch member connected to the wheels by flexible couplings, a clutch member connected to the motor, a liquid for connecting the two clutch members, and mechanism for controlling the flow of the liquid.

470,634. Telephone; William A. West, of Bellefontaine, O., Assignor of two-thirds to W. H. West and C. G. West, of same place. Application filed Nov. 12, 1883. The combination of a continuous main line, transmitting and receiving instruments therein, and a reinforcing device consisting a local circuit, means controlled by the main and local lines together for varying the current in the local circuit, and an indicator coil having its primary in the local and its secondary in the main circuit.

470,638. Electric Search-Light; Robert S. Dobbie, of Brooklyn, N. Y. Application filed April 16, 1891. The combination, in a projector or search-light, of an arc lamp having a frame, the base of which rests movably in sockets, and a feed-screw for the carbons detachably connected with a motor exterior to the projector.

Copies of the specifications and drawings complete of any patent mentioned in this record—or of any other patent issued since 1886—can be had for 25 cents. Give date and number of patent desired and address The W. J. Johnston Co., Ltd., Times Building, N. Y.